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A Volume in Honor of Geneva Sayre
on the Occasion of her 70th Birthday

Edited by: Donald H. Pfister
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No. 2. **I. Mackenzie Lamb**: *Stereocaulon arenarium* (Sav.) M. Lamb, a Hitherto Overlooked Boreal-Arctic Lichen (June 1972).

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No. 4. **I. Mackenzie Lamb, William A. Weber, H. Martin Jahns, Siegfried Huneck**: *Calathaspis,* a New Genus of the Lichen Family Cladoniaceae (July 1972).

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EDITORS' NOTE

For the Farlow Reference Library and Herbarium, the end of Geneva Sayre's teaching career at Russell Sage College was a beginning. With cheer and a large measure of good will she undertook, with Reed C. Rollins, the task of revitalizing the institution. Her sound judgments were always important; her interest and enthusiasm have never waned. From her, several "generations" of curatorial assistants have learned their trade. She has been and, we hope, will continue to be our friend and teacher.

Work on this volume began nearly two years ago. Since then, we have had the pleasure of writing to the contributors and learning a good deal about a number of topics. We wish to thank all of the contributors. Marshall Crosby gave advice and comments, particularly in the initial stages of the project. We regret that he was unable to join us in the volume. Reed and Kathryn Rollins deserve special thanks. Throughout the project they acted as advisors and confidants. We depended upon Ruth Z. Temple for information—her discretion was admirable. She also helped with editing and reading proofs. Professor Robert F. Gehrig, Russell Sage College, provided us with materials from that institution's archives; we thank him. Where else but in such clippings could we learn that Dr. Sayre narrated the program for the 1943 YWCA Christmas Party, that her first year she earned the grand salary of $1800, that she was cap and gown speaker in 1948, or that she taught Natural Sciences, General Biology, Botany, Human Physiology and Genetics all within one academic year?

> You may charge me with murder—or want of sense—
> (We are all of us weak at times):
> But the slightest approach to a false pretence
> Was never among my crimes!
>
> —*The Hunting of the Snark*,
> Lewis Carroll

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GENEVA SAYRE – TEACHER, SCHOLAR, BRYOLOGIST, BIBLIOGRAPHER AND HISTORIAN

William Campbell Steere*

During the long and distinguished professional career of Geneva Sayre, two particular qualities have shone forth with a special brilliance, her devotion to a high level of scholarship and her unshakeable dedication to public service. Her intellectual abilities manifested themselves early; while an undergraduate student at Grinnell College, she familiarized herself with the liberal arts and earned membership in Phi Beta Kappa – and became a botanist. Also, as an undergraduate she wisely decided to become a college teacher. Her first teaching position was as instructor at the University of Colorado for two years, immediately after she had been awarded her doctorate there. In 1940, she moved east to Russell Sage College and served on the faculty of that institution for thirty-two years, until her retirement in 1972 with the title of Professor Emeritus. At Russell Sage College, Geneva soon became famous as an outstanding teacher and person, and is remembered warmly by all the thousands of students who came under her influence through the years. Because of her own high scholastic standards, she demanded much of her students, but at the same time she rewarded them in equal measure with affection, humor, tact and wisdom. These qualities are evident in her commencement address to the Class of 1971 at Russell Sage College, as also in her profound scholarship and knowledge of the classics. An excerpt from this address, published in "The Sage" (1971) is indeed an inspirational and moving document, as it beautifully illustrates Geneva's own personal philosophy.

A splendid but little-known example of Geneva's warmheartedness and steadfastness of purpose was her work toward the establishment of a program for the alleviation of serious problems faced by bryologists in Europe at the end of World War II, thanks to an almost total breakdown of the economy and transportation systems, the widespread destruction, and all the other stresses inherent in a long and cruel war. Geneva took up the task (and the expense) of writing to her American bryological colleagues to ask them for contributions of money, books and other necessary items which were then forwarded, together with food and clothing, to bryologists in Europe, as a small, specialized and independent CARE-package operation. Although Geneva would be the first to disclaim any credit, the program was startlingly successful. Years later, several European bryologists told me, often emotionally, that the packages had undoubtedly saved their lives. Yet, in her curriculum vitae, Geneva makes no mention of this heroic and humanitarian chapter in her life.

Geneva Sayre's professional interest in mosses was aroused during her

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undergraduate days at Grinnell College, where she happened to be a student just when her professor, Henry S. Conard, another famous teacher, became interested in them. In fact, at that time there seems to have been a grass-roots movement among students and amateurs in Iowa toward the study of mosses, long a neglected group of plants there, a movement for which Dr. Conard soon accepted leadership. I am sure that Geneva was herself deeply involved in this movement and that she had a considerable influence on Dr. Conard's change of research emphasis from vascular plants to mosses.

Geneva's published bryological work eminently demonstrates her scholarship, her skill as a teacher and her devotion to public service. Many of her contributions during the earlier years were made in the form of monographic revisions designed to clarify difficult groups of mosses and to make them more accessible to her colleagues. Her long-continued studies on the difficult and badly understood genus *Grimmia*, and her excellent published key to the genus, have been especially helpful to both students and professional bryologists.

Later in her career, because of her scholarly bent and her obvious ability to think clearly and logically, Geneva was invited to serve on several international bryological committees whose mission was to look into and advise upon such questions as correct nomenclature, official starting points and dates for names, and plans for the proposed *Index Muscorum*. As a result of her involvement in these international responsibilities and activities, Geneva Sayre pioneered bibliographic and historical bryology, a new field of bryology which, again, required a high degree of scholarly experience for the study, evaluation and organization of the literature of bryology. With the acceptance of bryologists in 1931 of Hedwig's *Species Muscorum* (1801), instead of earlier works, as the official starting point for the nomenclature of Musci (except *Sphagnum*), there arose very naturally in the minds of bryologists a certain amount of anxiety and confusion concerning what should now be the acceptable—and accepted—names of mosses. In order to alleviate the problem, Geneva spent an aggregate of several years in library research in America and Europe and in 1959 published privately (in Troy) her invaluable *Dates of Publications Describing Musci, 1801–1821*. With this enormous task successfully completed, Geneva (again with the help of a grant from the National Science Foundation) embarked upon a much larger venture which required still further research in the major libraries and herbaria of the world in order to collect and collate information concerning published sets (exsiccatae) of green cryptogams, especially bryophytes, as well as to gather biographical and bibliographical information about bryological collectors. The five parts of her monumental work, *Cryptogamae Exsiccatae*, so far published (Memoirs of the New York Botanical Garden, 1969–1975) provide a veritable gold mine of exact and otherwise unavail-

able information for professional bryologists. Thus, Geneva Sayre, who evolved from a teacher-bryologist to a bryological bibliographer and bryological historian, has single-handedly created a unique, original and essential area of scholarship for which she will be long and gratefully remembered by the bryologists who use the fruits of her labors.

Geneva Sayre at work on Matinicus Island, Maine. By Bernice Smith.

GENEVA SAYRE – TOWN HISTORIAN

RUTH Z. TEMPLE*

Aptitude for historical research and zeal for public service have been demonstrated in Geneva's "leisure time" activities as well as in her professional life. Soon after acquiring an eighteenth century house in Chesterfield, Massachusetts, a very small town better known to geologists than to bryologists (except those of the latter persuasion who have visited her there), she turned her attention to the town's history, serving recurrently as President of the Historical Society and Curator of the Edwards Memorial Museum, and now for some years as Curator of Documents for the Society. In the last capacity, she devotes many hours weekly each summer to directing a group of volunteers in the indexing, transcribing, and encapsulating of town records, such as letters, journals, account books, deeds, and indentures. She was co-author of the town history written for the tricentennial history of Hampshire County, 1962, and, in that year, too, of an historical pageant illustrating the town's two centuries from local records. Since 1977 she has been the (elected) Chairman of the (appointed) Chesterfield Historical Commission and to date has written or edited the inventories of some 75 houses in town for the official records of the Commonwealth. She has put together a bibliography of printed and manuscript sources for Chesterfield history, and on this she draws to satisfy the curiosity of descendants of local families who stop by or write in quest of genealogical data or ancestral houses or gravestones. Indeed, letters addressed only "Town Historian" are routinely put into her mailbox.

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* Chesterfield, MA

GENEVA SAYRE – A PERSONAL NOTATION

Reed C. Rollins*

I first met Geneva at the University of Wyoming Summer Camp where, as students, we spent the summer of 1935. Field studies by our botany class were under the guidance of Aven Nelson, Paul B. Sears and W. G. Solheim. The differing interests of our professors insured that we looked carefully at the broad aspects of plant interrelationships, the diversity of plants and the diversity of vegetative types in the mountains and plains of southern Wyoming and northern Colorado. Nelson handled the higher plants, Solheim the lower plants and Sears ecology and vegetation types. From our base at the permanent camp in the Medicine Bow Mountains of Wyoming, we ranged widely on field trips to find the most suitable sites for study. Some of these lasted several days involving different outdoor campsites. I recall Geneva's evolving interest in mosses and especially her interest in the genus *Grimmia* which was frequently encountered in the habitats we studied. The field work she did then and later certainly contributed in a most essential way to the successful treatment of *Grimmia* that she later produced. As an aside, Geneva and I, as well as the other students, were much intrigued by Sears and his writing program. He spent every opportunity to write on his book, untitled then but later published as, *Deserts on the March*. This proved to be a penetrating and popular account of the development of the "dust bowl" of the lower plains region of North America.

Although I have kept in touch with Geneva over the years in a desultory way, primarily at national and international meetings, it was not until her retirement from Russell Sage College that our paths became more congruent. Since her appointment to the staff of the Farlow Library and Herbarium, we have worked together to help restore the Farlow to a fuller measure of botanical activity. In this, Geneva has been a key person whose devotion and sound judgment have contributed immeasurably to the successful realization of our aims. Her careful review of the collections and library uncovered a startling number of significant items previously overlooked. Among the bryological holdings especially, but throughout the Farlow, Geneva's knowledge of historical collections and literature has been most important in bringing these back into the mainstream of systematic research. She has played a unique role, and I am personally very grateful for her efforts and goodwill.

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*Gray Herbarium, 22 Divinity Ave., Cambridge, MA

PLATE 1. University of Wyoming Summer Camp botany class, Northern Colorado, Summer, 1935. Photograph by W. G. Solheim, Geneva Sayre is third from the left; Reed Rollins is directly behind the smoke. Also in the photograph are Paul B. Sears with the mustache and Aven Nelson, the white-haired gentleman on the right.

PUBLICATIONS OF GENEVA SAYRE

GERALDINE C. KAYE*

1934 Mosses of southwestern Iowa. Proc. Iowa Acad. Sci. **41**: 105–106. (with H. S. CONARD).
The Grimmias of Iowa. Bryologist **37**: 29–34.
Decurrent leaf cells in *Climacium*. Bryologist **37**: 83–85.

1935 *Splachnaceae; Timmiaceae, Aulacomniaceae.* Pages 89–102, 145–152 *in* A. J. Grout, Moss flora of North America north of Mexico, vol. 2. Newfane, Vt.: the author.
Spring flora of the Laramie area. Mimeographed, University of Wyoming.

1936 Note on mosses as fish food. Bryologist **39**: 39–40.

1937 The moss genus *Grimmia* in Colorado. [Abstract.] J. Colorado-Wyoming Acad. Sci. 11(3): 65–66.

1938 Progress in the study of Colorado mosses. [Abstract.] J. Colorado-Wyoming Acad. Sci. 11(4): 22–23.
The moss flora of Colorado. [Abstract.] Univ. Colorado Stud. **26**: 123–126.

1940 Mosses of the Santa Barbara Islands. Bryologist **43**: 33–36.
West Virginia liverworts. [Review of: Nelle Ammons, a manual of the liverworts of West Virginia.] Ecology **21**: 406.

1941 A gum arabic mounting medium. Bryologist **44**: 160.
Keys to the flowering plants of the mountains of Boulder County, Colorado. Mimeographed, University of Colorado.

1944 Colorado species of *Grimmia*. Bryologist **47**: 118–122.

1945 The distribution of *Fontinalis* in a series of moraine ponds. Bryologist **48**: 34–36.

1946 The taxonomic rank of *Grimmia alpicola*. Bryologist **49**: 3–7.

1947 The Society's program of international aid. Bryologist **50**: 509–511.

1948 Fuegian and Patagonian mosses. [Announcement.] Bryologist **52**: 48.

1950 Albert Latzel. [Obituary.] Bryologist **53**: 248.

1951 A rolling stone. Russell Sage Alumnae Quarterly **20**: 10–12.
The identity of *Grimmia ovalis* and *Grimmia commutata*. Bryologist **54**: 91–94.

1952 Spore dispersal in mosses. New York Bot. Gard. J. **2**: 51–53.
Key to the species of *Grimmia* in North America. Bryologist **55**: 251–259.

1954 A new variety of *Grimmia trichophylla* from Indiana. Bryologist **57**: 21–25.

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*Farlow Reference Library

Hedwig, 1801, and the nomenclature of mosses. VIII Congrès International de Botanique (Paris), Rapports et communications, vol. prélim. **14–16**: 108–113.

1955 E. T. Bodenberg, Mosses: A new approach to the identification of common species. [Review.] New York Bot. Gard. J. **5**: 172.

Grimmia mariniana, a new species from California. Bryologist **58**: 323–325.

1956 Some of my best friends. . . Russell Sage Alumnae Quarterly **26**: 7–8.

1957 Publications on mosses in 1801. Taxon **6**: 10–12.

1959 Dates of publications describing Musci, 1801–1821. Troy, N.Y.: the author. 102 p.

Priority of publication of names of *Musci*, 1801–1821. [Abstract.] Proc. IX International Botanical Congress (Montreal) **2**: 344.

1962 Publication dates of early botanical books. [Abstract.] Pages 139–140 *in* International Congress of the History of Science. Ithaca, N.Y.

General biology laboratory directions. Sand Lake, N.Y.: the authors. 82 p. (with Joseph Moran).

Old Chesterfield houses. Pages 36–44 *in* Two hundredth anniversary of the incorporation of Chesterfield, Mass. 1762–1962.

1964 Chesterfield. Pages 40–52, 346–347 *in* Lawrence E. Wikander, ed., The Hampshire history. Northampton, Mass.: Hampshire County Commissioners. (with Ruth Z. Temple and Ruth A. Baker).

The authorities for the epithets for mosses, hepatics, and lichens. Bryologist **67**: 113–135. (with C. E. B. Bonner and William L. Culberson).

1965 S. W. Gould and D. C. Noyce, Authors of plant genera: vol. 2 of International plant index. [Review.] Bryologist **68**: 482–483.

1969 Cryptogamae exsiccatae—an annotated bibliography of published exsiccatae of Algae, Lichenes, Hepaticae, and Musci. Parts I–III, General cryptogams, Algae, Lichenes. Mem. New York Bot. Gard. **19**: 1–174.

1971 Cryptogamae exsiccatae. Part IV, Bryophyta. Mem. New York Bot. Gard. **19**: 175–276.

Upon leaving Russell Sage. The Sage, Troy, N.Y., October, p.3.

1974 Recent developments at the Farlow Herbarium. Taxon **23**: 215–216.

1975 Cryptogamae exsiccatae. Part V, Unpublished exsiccatae: collectors. Mem. New York Bot. Gard. **19**: 277–423.

Illustrations of the lost hepatics of the Wilkes Expedition. Bryologist **78**: 204–205.

1976 The type herbarium of the Flora Boreali-Americana. Rev. Bryol. Lichénol. **42**: 677–681.

1977 Authors of names of bryophytes and the present location of their herbaria. Bryologist **80**: 502–521.

1978 Musci by William Starling Sullivant and Leo Lesquereux, edited by Geneva Sayre. Pages 127–179 *in* Cryptogams of the United States North Pacific Exploring Expedition, 1853–1856. Cambridge, Mass.: Farlow Herbarium.

AN INVENTORY OF JOHN MACOUN'S CANADIAN MUSCI

HOWARD CRUM*

In his autobiography, John Macoun noted that he arranged, in 1882, for the government of Canada to take over his herbarium which, as he said, had "increased wonderfully, as had all the collections I had been making for the last three years while on government work. I had some difficulty about the terms, but it was agreed that the government would take over. . .only the flowering plants. The mosses and other material were not to be paid for, and I retained these as, for many years I had been selling sets of them." His specimens of flowering plants, representing 7000 species, formed the basis for the National Herbarium of Canada. There is, as far as I know, no record of the final disposition of his bryophyte herbarium. The National Herbarium has a large number of specimens labeled in Macoun's hand, many of them bearing names provided by Kindberg or Kindberg and C. Mueller (but with no numbers or other means of relating them to type specimens in Kindberg's herbarium). There are none of the early collections that were named by Mitten, Sullivant, Austin, or James, and not even a complete set of Macoun's exsiccatae, the *Canadian Musci*, which were distributed in seven centuries sometime between December of 1887 and late 1893 (or possibly early 1894). The *Canadian Musci* have considerable interest because a large number of Kindberg's novelties are included among them and also because the specimens have been so extensively cited in the taxonomic literature of the past eight decades.

Macoun sold the specimens or exchanged them for other specimens or for literature. Distribution was erratic because it depended on the receipt of orders, or "subscriptions." He published no schedae and left no list. The heading *Canadian Musci* was used for this set, with printed labels (except for one number), and also for incidental collections with handwritten data. To compound the confusion associated with all of Macoun's bryological activities (not the least of which was his long involvement with Kindberg's taxonomic efforts), other bryologists have greatly confused the *Canadian Musci* with the *Canadian Mosses*. The *Canadian Mosses* had labels with a printed heading, but in most cases partly or completely handwritten data. They represented a miscellany of specimens issued in odd lots rather than a series of mass collections intended to serve as a standard of reference. As exsiccatae the *Canadian Musci*, numbering 670 in all, also leave much to be desired. Many of the numbers represent collections from two or more localities—or no specific locality—and many were distributed with labels altered by hand or with handwritten evidence on the wrappers of a different time and date of origin. Macoun was an enthusiastic and indefatigable collector, no doubt sharp-eyed and

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astute, but he was not as skilled at taxonomic bryology as he thought he was. He apparently sent representative specimens to Kindberg for naming and then matched up other collections with what he thought were Kindberg's concepts. Thus, the Kindberg names used on the labels of the *Canadian Musci* cannot be taken too seriously. None of the labels include descriptions of novelties, although some of them present new names antedating descriptions and perhaps some new combinations, with or without basionyms.

On March 31, 1891, Macoun wrote Elizabeth G. Britton, of the New York Botanical Garden, "You have the earliest centuries sent out. I kept no account of dates." Distribution of the *Canadian Mosses* probably overlapped with that of the *Musci*. Of them Macoun wrote Mrs. Britton nearly three decades later, on June 3, 1918, "There is no use in me trying to give you the dates. All I know is one series was published before 1892 and another after. I have no data here [in Sidney, British Columbia], and I cannot tell you if there are any in Ottawa." Mrs. Britton wrote in return, on June 11, that neither she nor Dr. Farlow, of Harvard University, kept any records.

The list of specimens presented below was compiled as a result of herbarium and literature searches extending over a 25-year period, and information on dating the distribution of centuries was culled, for the most part, from the extensive Macoun-Britton correspondence preserved at the National Herbarium of Canada and the New York Botanical Garden.

CENTURY I, NOS. 1–100. The date of publication surely precedes May 22, 1888 when Macoun wrote Mrs. Britton concerning "the century already sent." One week later he sent her a list of 24 corrections made by Kindberg. Kindberg's set was presumably sent to him sometime in 1888, as the "Notes and News" section of the *Botanical Gazette* for December 1887 included a notice that the first century was "about ready" for distribution. (Macoun told C. R. Barnes on March 14, 1889 that the first century was advertised in the *Botanical Gazette*, but no subscribers resulted and so he would advertise no more.)

CENTURY II, NOS. 101–200. On December 8, 1888, Macoun wrote George L. Smith, of Baltimore, that it was nearly two months since he had sent century II to Europe, "so as to have the specimens examined by Kindberg, Renauld, and Cardot. I expect the results next week when I will make the necessary corrections and forward no. 3 of Century II to you." On November 12, Kindberg wrote that the "second Century is not arrived to me," but on January 14, 1889 he sent Macoun a list of 25 corrections. Macoun wrote Mrs. Britton on December 14, 1888, "In a short time I will send you Century no. II," but he did not send it until January 15, together with Kindberg's corrections. It seems curious that George Smith received a set well before Mrs. Britton did, as she and Macoun were in lively cor-

respondence. George Lawson's set was mailed on January 15 and L. M. Underwood's on January 16. A set went out to an unnamed "Sir" on January 17 and to Clara Cummings on January 22. (Macoun told Mrs. Britton on February 20 that only half a dozen sets had been sent out as very few Americans wanted them.)

CENTURY III, NOS. 201–300. Macoun wrote Mrs. Britton on February 20, 1889 that Century III was ready for distribution, but "without subscribers" it would not be sent out until the following winter. Five days later he wrote Clara Cummings that it would "be out next month, but without you desire to have it, it will not be sent to you until October." On March 4 he wrote Mrs. Britton that Century III would be sent her the next day. In a manuscript review dated March 12 Mrs. Britton stated that it had been sent in advance at her request. A set went to L. M. Underwood on March 14, but there must have been a delay in receipt as Macoun wrote Underwood on March 28, "Should you not have received the 3rd Century by this time, enquire at the Customs Dept. of your City. The parcel certainly went with my letter." Kindberg's set was sent much later. On October 28, 1889 Macoun told Mrs. Britton that he had sent the century to him. Kindberg acknowledged receipt on November 5 and sent 14 corrections, presumably at the same time.

CENTURY IV, NOS. 301–400. On March 4, 1889 Macoun told Mrs. Britton that Century IV was complete but could not be issued until the following winter owing to his planned departure for British Columbia by the first of April. On September 17 he wrote Charles Bessey that the "tickets" were being printed at that time, and on September 26, he wrote, "Today I send four Centuries of Mosses to your address and include the last one before the tickets are printed, but these will be sent down in a few days." It appears, however, that Century IV was not actually sent until October 4, and a letter on October 5 said that the labels would follow in a day or two. Macoun told L. M. Underwood on October 7, "I will send both the third and fourth centuries of mosses by the end of the week," but on the 10th his son, J. M. Macoun, wrote, "My father is taking advantage of the fine weather to spend his time in the woods, but the first bad day he will get out Centuries III and IV for you." They were sent on October 12. Century IV had already been sent to George Lawson, with "corrected tickets," on October 8. Centuries II, III, and IV went to Kew on October 16. Macoun told Mrs. Britton, on October 11, that Century IV would be sent to her in a day or two, but it was not sent until October 21; a list in her handwriting was marked as "received October 23, 1889." On November 22, Macoun wrote Mrs. Britton, "Find enclosed a bill for Century IV which I receipt. For it send me a receipt for one hundred of Leiberg's Mosses, one year's subscription to the Bulletin, and a receipt in duplicate for Bailey's Studies of the genus Carex, Martindale's paper on sea-weed, and the next paper that comes out."

CENTURY V, NOS. 401–500, VI, NOS. 501–525. Century V went to Mrs. Britton in two installments. On November 22, 1889, Macoun wrote her that 50 specimens were ready and might be distributed the following spring, but on December 13, he wrote that he would send the first 25 in a few days. For some reason, however, it was not until October 22, 1890 that he forwarded 70 specimens and asked her not to pay for them until the balance had been received. Mrs. Britton prepared a list of nos. 401–471 "received October 24, 1890." No. 453 was marked in pencil as received later, on January 6, 1891. On October 27 Macoun wrote that he would send the remainder of Century V "without tickets" in a few days, but they apparently went much later, as he wrote on December 30 that 50 numbers—"up to 525" in Century VI—were being sent. Mrs. Britton prepared a list of nos. 473–525 and noted that they were received on January 3, 1891. She acknowledged their receipt, however, in a letter of January 2! (Number 472 was not accounted for on either of her lists.) It thus appears that the specimens went out before New Years Day and presumably on December 30, as Macoun said. The labels were very likely included with the specimen, as Macoun (in his letter of December 30) said, "Should any tickets be missing, please let me know." In her letter of January 2, Mrs. Britton said that she would prefer to pay for the fifth century because "Leiberg is not collecting much now, being very busy with his mining, and I do not want to distribute any that are not choice and in sufficient quantity to make it worthwhile." Macoun told her (on January 12) that she owed him $8.00 for the century, but added, "Please keep out of it the subscription for the Torrey Bulletin or, if you choose, let the subscription go for the 25 of Century VI sent." Demetrio paid for specimens 471–525 on January 13, 1891.

CENTURY VI, NOS. 525–600. On May 18, 1891 Macoun told Mrs. Britton, "I believe I will have enough specimens to make out Century VI next autumn," but it was not until 1893, on February 28, that he sent her the labels for "the balance of Century VI." Other sets seem to have been distributed about the same time, as Daniel C. Eaton paid $16.00 for Century VI and a "Century of Lichens" on March 10, 1893. Four of the specimens were collected in the summer of 1892, no. 599 as late as July 28. (In his letter to Mrs. Britton on February 28, Macoun made reference to no. 597 which was one of those collected in 1892.) It appears then that distribution was sometime between the last known date of collection, July 28, 1892, and February 28, 1893 when Macoun sent Mrs. Britton the labels for specimens which she had already received.

CENTURY VII, NOS. 601–670. Thirty-five of these specimens were collected in 1893, three of them as late as October 10 and 16. No references to the final Century were found in Macoun's letters, but Mrs. Britton referred to no. 666 in a letter of May 9, 1894. The only information on distribution otherwise was provided in a letter of January 11, 1895 when

E. L. Norris of Amherst College wrote that he had purchased the first six Centuries a few years previously and asked what Macoun had "in Centuries of Musci above no. 600." On January 22 he placed an order for nos. 601–670. This is the only evidence I have that the *Canadian Musci* ended with no. 670.

Macoun may have traded his *Canadian Musci* and *Canadian Mosses* for specimens and literature with others, as he did with Mrs. Britton. On February 25, 1895, Daniel C. Eaton asked for a set of mosses (probably the *Canadian Mosses*) but said that he preferred to buy rather than exchange specimens owing to the uncertainty of his health. On June 3, 1902 Mrs. Britton sent a "second installment" of duplicates from Jaeger's herbarium, including the remainder of Sullivant and Lesquereux's Musci Boreali-Americani and a miscellany of European mosses. She referred to these as the first set of duplicates and said, "It nearly cancels our exchange for the remainder of the *Canadian Mosses*—though I feel with you that we do not need a debit and credit account, and if there is any way in which I can go you one better, I am glad to do it in acknowledgment of all your kindness."

Macoun at first charged $8.00 per century, but on November 23, 1891 he told Mrs. Britton that he was going to reduce the price to $6.00 per hundred because of the depletion of scarcer species. There is no information on how many duplicate sets were distributed. It appears from the correspondence relating to distribution that there were only a limited number. In his correspondence Macoun mentioned his intention of replacing material that had been issued under the wrong names, and it is obvious that he often used the same labels for specimens collected at different times and places. Obviously the *Canadian Musci* cannot be cited effectively as an exsiccatae set worthy of reference. Too many of the specimens were misnamed. Considerable confusion has resulted from the fact that every species listed in Macoun's *Catalogue of Canadian Plants* was assigned a number. This number was used in filing material in his herbarium, and therefore all specimens originally in his herbarium and many distributed to subscribers of the exsiccatae bore this number in addition to the number printed on the label (which was, as often as not, crossed out). In Grout's *Moss Flora* as many as 139 citations to the *Canadian Musci* are listed according to this catalogue number. In his revision of the North American Dicranaceae in the North American Flora, Williams failed to distinguish between the *Canadian Musci* and the *Canadian Mosses*. Similar errors are to be found in Grout's *Moss Flora*. For example, in the monograph on the Grimmiaceae alone, 29 references to the *Canadian Musci* actually refer to the *Canadian Mosses*. The problem is complicated by the fact that in addition to the exsiccatae set issued as the *Canadian Musci*, Macoun issued other material with handwritten labels with a

printed heading *Canadian Musci*. Such specimens have nothing to do with the exsiccatae set and are represented in very few herbaria. At least thirty references to the *Canadian Musci* given in Grout's *Moss Flora* are of this type. Carelessness in citation has also contributed confusion. For example, again in Grout's *Moss Flora*, two specimens of *Canadian Cryptogams* are cited as *Canadian Musci* and at least two specimens without labels but with number and data written on the card on which the plants were mounted are referred to as *Canadian Musci*. In addition some 13 of Macoun's specimens are cited merely by number, without title of exsiccatae, three of which refer to the *Canadian Musci*.

1. *Sphagnum acutifolium* Ehrh. Very common in swamps and peat bogs.
2. *Sphagnum acutifolium* var. *fuscum* Schimp. Peat bogs, Lake Superior.
3. *Sphagnum acutifolium* var. *purpureum* Schimp. Peat bogs, Ontario.
4. *Sphagnum acutifolium* var. *confertum* Aust. Peat bogs, Lake Superior.
5. *Sphagnum rubellum* Wils. Louisburg, Nova Scotia, and Anticosti.
6. *Sphagnum strictum* Lindb. Peat bogs, Ontario.
7. *Sphagnum cuspidatum* Ehrh. Ponds in bogs, Lake Superior.
8. *Sphagnum cuspidatum* var. *biforme* Braithw. Peat bogs, Anticosti. Also distributed as *S. mendocinum* Sull. & Lesq. In a peat bog, Anticosti, Aug. 12, 1883.
9. *Sphagnum intermedium* Hoffm. Peat bogs and cedar swamps, Ontario.
10. *Sphagnum squarrosum* Pers. Wet places, in pine woods, Ontario.
11. *Sphagnum wulfianum* Girg. Peat bogs, Hastings, Co., Ontario.
12. *Sphagnum rigidum* Schimp. Peat bogs, Portage La Loche, Lat. 57°, 1875.
13. *Sphagnum subsecundum* Nees. Rather common in swamps at Point aux Pins, Lake Superior, Aug. 1869. Also distributed as *S. subsecundum* Nees. Bogs along Lake Superior.
14. *Sphagnum tenellum* Ehrh. Peat bogs, Anticosti.
15. *Sphagnum cymbifolium* Ehrh. Swamps and peat bogs, common.
16. *Andreaea petrophila* Ehrh. Wet granite rocks, Lake Nipigon, Ont.
17. *Gymnostomum curvirostrum* Hedw. Wet rocks in a ravine, Ontario.
18. *Gymnostomum rupestre* Schwaegr. On flat limestone rocks, Owen Sound, Ont.
19. *Dicranoweisia cirrhata* Lindb. On rocks, Rocky Mountains.
20. *Cynodontium gracilescens* Schimp. On wet rocks, Lake Superior. Also distributed as *C. subalpestre* Kindb. Islands in Lake Nipigon, July 1884.
21. *Cynodontium polycarpum* Schimp. On rocks, Mount Benson, Vancouver Island.
22. *Cynodontium virens* Schimp. Peat bogs and wet woods, Anticosti.
23. *Cynodontium virens* var. *wahlenbergii* Bruch & Schimp. On dead logs in woods, Ottawa, Ont.
24. *Trematodon ambiguus* Hornsch. Roadsides, Hastings Co., Ont.
25. *Aongstroemia longipes* Bruch & Schimp. Amongst sand, Selkirk Mountains, B.C.
26. *Dicranella varia* Schimp. Along roadsides and in ditches, Ontario.
27. *Dicranella rufescens* Schimp. Wet clay banks, Truro, N.S.
28. *Dicranella subulata* Schimp. Peat bogs, Anticosti.
29. *Dicranella heteromalla* Schimp. On wet banks at Ottawa, Ont.
30. *Dicranum starkei* Web. & Mohr. Fissures of rocks on mountains, Vancouver Island.
31. *Dicranum falcatum* Hedw.? Peat bogs, Anticosti.
32. *Dicranum blyttii* Bruch & Schimp. Mount Benson, Vancouver Island.
33. *Dicranum strictum* Schleich. On decayed trunks, Vancouver Island.
34. *Dicranum montanum* Hedw. On the bases of trees, in woods, Gaspé, Que.
35. *Dicranum viride* Schimp. On the stems of trees, always sterile, Ottawa, Ont.
36. *Dicranum flagellare* Hedw. On rotten logs in woods, Ottawa, Ont.
37. *Dicranum fulvum* Hook. On granite boulders, Belleville, Ont.
38. *Dicranum longifolium* Hedw. On granite rocks, Lake Superior.
39. *Dicranum fuscescens* Turn. Abundant on logs, Lake Superior.

40. *Dicranum fuscescens* Turn. Var. On old logs, Lake Superior.
41. *Dicranum fragilifolium* Lindb. In woods, Vancouver Island.
42. *Dicranum scoparium* Hedw. Very abundant on earth in woods, Ontario.
43. *Dicranum scoparium* Hedw. var. *recurvatum*. On the bases of trees in woods, Ontario.
44. *Dicranum majus* Turn. Damp woods, Halifax, N.S.
45. *Dicranum schraderi* Web. & Mohr. Peat bogs, abundant, Ontario.
46. *Dicranum spurium* Hedw. On sand and rocks, Yarmouth, N.S.
47. *Dicranum drummondii* Muell. Cedar swamps, Ontario.
48. *Dicranum undulatum* Turn. Cedar swamps and pine woods, Ontario.
49. *Fissidens bryoides* Hedw. On earth in woods, Ontario.
50. *Fissidens incurvus* Schwaegr. On shaded rocks in woods, Ottawa.
51. *Fissidens osmundioides* Hedw. On roots of trees in swamps, Ontario.
52. *Fissidens adiantoides* Hedw. On roots of trees in swamps, Ontario.
53. *Fissidens grandifrons* Brid. On stones in running water, Ontario.
54. *Conomitrium hallianum* Sull. & Lesq. On stones in brooks, Hastings Co., Ont.
55. *Leucobryum vulgare* Hampe. On earth in damp woods, Ontario.
56. *Ceratodon purpureus* Brid. Common on earth everywhere, Ontario.
57. *Distichium capillaceum* Bruch & Schimp. Wet banks of rivers and ravines, Ontario.
58. *Distichium inclinatum* Bruch & Schimp. North shore of Lake Superior, Ontario.
59. *Seligeria pusilla* Bruch & Schimp. Shaded limestone rocks, Ottawa.
60. *Seligeria recurvata* Bruch & Schimp. On limestone rocks at Owen Sound.
61. *Blinda acuta* Bruch & Schimp. On rocks, Nanaimo River, Vancouver Island.
62. *Pottia truncata* Fuernr. Earth on limestone rocks, Gaspé Coast.
63. *Didymodon rubellus* Bruch & Schimp. On rocks along rivers, Ontario.
64. *Didymodon luridus* Hornsch. On rocks, Owen Sound, 1871.
65. *Leptotrichum tortile* Muell. On roadsides, Truro, N.S.
66. *Leptotrichum flexicaule* Hampe. Crevices of rocks, Rocky Mountains.
67. *Leptotrichum pallidum* Hampe. On earth in woods, western Ontario.
68. *Leptotrichum glaucescens* Hampe. On banks along lakes, Ontario.
69. *Desmatodon latifolius* Brid. On rocks, Gaspé Coast, 1882.
70. *Desmatodon porteri* James. On rocks, Gaspé Coast, 1882.
71. *Desmatodon cernuus* Bruch & Schimp. On earth, wet rocks, Gaspé Coast.
72. *Barbula brevirostris* Bruch & Schimp. Under trees at Morley, Rocky Mountains.
73. *Barbula unguiculata* Hedw. On earth by roadsides, Ontario.
74. *Barbula laevipila* Bruch & Schimp. On rocks, Vancouver Island.
75. *Barbula rubiginosa* Mitt. On rocks, Vancouver Island.
76. *Barbula convoluta* Hedw. On the ground in pastures, Ontario.
77. *Barbula tortuosa* Web. & Mohr. On dry limestone rocks, Ontario.
78. *Barbula fragilis* Bruch & Schimp. On rocks in stream, Gaspé.
79. *Barbula megalocarpa* Kindb. On rocks, British Columbia.
80. *Barbula mucronifolia* Bruch & Schimp. On rocks along stream, Belleville, Ont.
81. *Barbula cylindrica* Schimp. On earth in ditches, Vancouver Island.
82. *Barbula ruralis* Hedw. On limestone rocks, Belleville, Ont.
83. *Barbula muelleri* Bruch & Schimp. On rocks, Vancouver Island.
84. *Grimmia conferta* Funck. On rocks, Lake Superior.
85. *Grimmia apocarpa* Hedw. On dry rocks, Ottawa, Ont.
86. *Grimmia apocarpa* var. *gracilis* Nees & Hornsch. On dry rocks, Lake Superior.
87. *Grimmia apocarpa* var. *rivularis* Nees. On rocks in streams, Ontario.
88. *Grimmia maritima* Turn. On rocks near the sea, Vancouver Island.
89. *Grimmia anodon* Bruch & Schimp. On dry rocks, Rocky Mountains.
90. *Grimmia pulvinata* Smith. On dry rocks, Vancouver Island.
91. *Grimmia torquata* Grev. On rocks, Rocky Mountains.
92. *Grimmia trichophylla* Grev. On rocks, Rocky Mountains.
93. *Grimmia californica* Sull. Rocky Mountains and Vancouver Island.
94. *Grimmia commutata* Hueb. On rocks, Lake Nipigon and Rocky Mountains.
95. *Grimmia unicolor* Grev. Rocks along Lake Superior.
96. *Racomitrium patens* Hueb. On wet rocks, Vancouver Island.
97. *Racomitrium aciculare* Brid. On wet rocks, Lake Superior.

98. *Racomitrium sudeticum* Bruch & Schimp. On rocks, Lake Superior.
99. *Racomitrium heterostichum* Brid. On dry rocks, Vancouver Island.
100. *Racomitrium heterostichum* var. *obtusum* Kindb. On shores by the Nanaimo River, Vancouver Island.
101. *Racomitrium microcarpum* Brid. On rocks, Lake Superior and Vancouver Island.
102. *Racomitrium lanuginosum* Brid. Wet rocks, Louisburg, Cape Breton.
103. *Racomitrium canescens* Brid. Wet sand and rocks, Lake Superior.
104. [In Macoun's Catalogue cited as *Racomitrium oreganum* which was also referred to the synonymy of *R. varium*.]
105. *Scouleria aquatica* var. *virescens* Kindb. On rocks close to the Glacier Hotel, Selkirk Mountains, 1895.
106. *Hedwigia ciliata* Ehrh. On boulder in woods, Ontario.
107. *Hedwigia ciliata* var. *leucophaea* Schimp. On rocks, Vancouver Island.
108. *Hedwigia ciliata* var. *viridis* Schimp. On boulders at Ottawa, Ont.
109. *Pseudobraunia californica* Lesq. On rocks, Vancouver Island.
110. *Amphoridium lapponicum* Schimp. On rocks, Lake Superior.
111. *Amphoridium californicum* James & Lesq. Shaded damp rocks at Goldstream and Nanaimo, Vancouver Island; also at Agassiz, B.C. Also distributed as *Amphoridium sullivantii* James & Lesq. On damp rocks, Vancouver Island.
112. *Ulota ludwigii* Brid. On trees, Truro, N.S.
113. *Ulota crispa* Brid. On trees in woods, Ontario.
114. *Ulota crispula* Brid. On trees in woods at Ottawa.
115. *Ulota americana* Mitt. On rocks, Rocky Mountains.
116. *Ulota phyllantha* Brid. On the base of trees, Yarmouth, N.S.
117. *Ulota hutchinsiae* Schimp. On rocks, Lake Superior and Gaspé Coast.
118. *Orthotrichum anomalum* Hedw. On rocks, Ottawa, Ont., and Rocky Mountains.
119. *Orthotrichum texanum* Sull. On rocks, Coast Range, B.C.
120. *Orthotrichum speciosum* Nees. On rocks and trees, Rocky Mountains.
121. *Orthotrichum watsoni* James. On rocks, Rocky Mountains.
122. *Orthotrichum sordidum* Sull. & Lesq. On trees, Lake Superior.
123. *Orthotrichum psilocarpum* James. On trees, rather rare, Ontario.
124. *Orthotrichum strangulatum* Beauv. On trees throughout Ontario.
125. *Orthotrichum consimile* Mitt. On trees and rocks, Vancouver Island.
126. *Orthotrichum leiocarpum* Bruch & Schimp. On trees in swamps, common in Ontario.
127. *Orthotrichum pulchellum* Brunt. On trees, Vancouver Island.
128. *Orthotrichum obtusifolium* Schrad. On poplar trees, cool woods, Ontario.
129. *Orthotrichum jamesianum* Sull. On rocks, Coast Range, B.C.
130. *Orthotrichum lyellii* Hook. & Tayl. On trees, Vancouver Island.
131. *Encalypta rhabdocarpa* Schwaegr. Fissures of rocks, Rocky Mountains.
132. *Encalypta ciliata* Hedw. Crevices of rocks, common from Ottawa westward.
133. *Encalypta macounii* Aust. Abundant on rocks, Wellington Mine, Vancouver Island.
134. *Encalypta selwynii* Aust. Fissures of rocks, Rocky Mountains and Vancouver Island.
135. *Encalypta streptocarpa* Hedw. Crevices of rocks, Rocky Mountains, and Lake Huron.
136. *Tetraphis pellucida* Hedw. Abundant on rotten stumps in woods throughout Canada.
137. *Schistostega osmundacea* Web. & Mohr. On turned up roots, Rocky Mountains and British Columbia.
138. *Dissodon froelichianus* Grev. & Arn. On damp earth, mountain summits, Rocky Mountains.
139. *Dissodon splachnoides* Grev. & Arn. Summit of Mount Albert, Gaspé, and Selkirk Mountains, B.C.
140. *Tayloria serrata* Bruch & Schimp. Woods, Straits of Canso, N.S., and on earth, Vancouver Island.
141. *Tayloria tenuis* Schimp. In woods, Little Fox River, Gaspé, Que.
142. *Tetraplodon angustatus* Bruch & Schimp. In the northern forest on the droppings of carnivorous animals.
143. *Tetraplodon mnioides* Bruch & Schimp. With the preceding, more abundant.
144. *Splachnum sphaericum* Linn. f. Bogs at Morley, Rocky Mountains.
145. *Splachnum ampullaceum* Linn. Bogs, Cape Breton Island, Canso, N.S., and at Lake Nipigon.

146. *Physcomitrium hookeri* Hampe. On earth in pastures at Belleville, Ont., and along Lake Manitoba, Man.
147. *Physcomitrium megalocarpum* Kindb. On earth in meadow, Cedar Hill, Vancouver Island.
148. *Funaria hygrometrica* Sibth. Very common on the ground in burnt woods.
149. *Bartramia oederiana* Sw. Crevices and damp faces of rocks, not common.
150. *Bartramia pomiformis* Hedw. Quite common, rocks in cool ravines.
151. *Philonotis leoiphylla* Kindb. *Bartramia menziesii* Turn. On rocks, uncommon, Vancouver Island.
152. *Philonotis macounii* James & Lesq. On wet and shaded rocks, Nanaimo, Vancouver Island.
153. *Philonotis fontana* Brid. In ditches, springs and on dripping rocks; very common.
154. *Catoscopium nigritum* Brid. On the shores of Lake Huron in the Rocky Mountains [sic].
155. *Amblyodon dealbatus* Beauv. In bogs, Nova Scotia, and on Peace River, Lat. 56°.
156. *Meesia uliginosa* Hedw. Abundant along river margins in Quebec and Ontario.
157. *Meesia tristicha* Bruch & Schimp. Peat bogs in the Rocky Mountains and British Columbia.
158. *Paludella squarrosa* Brid. Swamps in the Rocky Mountains and British Columbia.
159. *Leptobryum pyriforme* Schimp. Abundant in woods where fire has been.
160. *Webera nutans* Hedw. On hummocks in bogs, quite common.
161. *Webera cruda* Schimp. Crevices of rocks, Lake Superior and the Rocky Mountains.
162. *Webera annotina* Schwaegr. Margins of springs and on wet rocks, Lake Superior and Vancouver Island.
163. *Webera lescuriana* James & Lesq. On wet clay soil, Truro, N.S.
164. *Webera pulchella* Schimp. Rocky Mountains and at Yale, B.C.
165. *Webera albicans* Schimp. Wet sand around springs and on wet rocks, Vancouver Island.
166. *Bryum purpurascens* Bruch & Schimp. Wet rocks, Anticosti and Gaspé Coast.
167. *Bryum pendulum* Schimp. On the ground in wet woods, Ontario.
168. *Bryum uliginosum* Bruch & Schimp. Crevices of rocks, Gaspé Coast and in the Rocky Mountains.
169. *Bryum intermedium* Brid. Wet rocks along rivers, quite common.
170. *Bryum bimum* Schreb. Very common in wet woods.
171. *Bryum provinciale* Phil. Along roadsides and on rocks at Comox and Victoria, Vancouver Island.
172. *Bryum pallescens* Schleich. Fissures of rocks, Lake Superior, and along the coast of Vancouver Island.
173. *Bryum alpinum* L. On rocks along the coast of Anticosti and on Mount Albert, Gaspé.
174. *Bryum muehlenbeckii* Bruch & Schimp. On rocks along the Moira at Belleville, Ont.
175. *Bryum miniatum* Lesq. On rocks along the sea coast, Vancouver Island.
176. *Bryum atwateriae* Muell. Abundant on wet rocks by the sea, Vancouver Island.
177. *Bryum argenteum* L. Chiefly var. *lanatum*. On roadsides, walls, and exposed places.
178. *Bryum caespiticium* L. Old pasture fields and exposed hillsides, Ontario to British Columbia.
179. *Bryum capillare* L. On the roots of trees at Belleville, Ont., and westward to Vancouver Island.
180. *Bryum capillare* var. *brevicuspidatum* Kindb. On rocks near Victoria, Vancouver Island.
181. *Bryum obconicum* Hornsch. On rocks, at Nanaimo and Vesuvius Bay, Vancouver Island.
182. *Bryum duvalii* Voit. Springy places in Ontario and in the Rocky Mountains.
183. *Bryum pseudotriquetrum* Schwaegr. Abundant in swamps chiefly in the mountains.
184. *Bryum roseum* Schreb. On old logs in rich woods throughout Ontario.
185. *Bryum intermedium* Brid. var. On rocks in oak woods, Vancouver Island.
186. *Bryum murale* Wils. On the shore of Shawnigan Lake, Vancouver Island.
187. *Bryum hydrophilum* Kindb. Wet springy places near Nanaimo, Vancouver Island. Also distributed as *B. meesioides* Kindb. On borders of ditches at Cedar Hill, Vancouver Island, May 1887.
188. *Webera tozeri* Schimp. On earth on a wet bank, Goldstream, Vancouver Island.

189. *Mnium cuspidatum* Hedw. Abundant in shady woods on the ground.
190. *Mnium venustum* Mitt. Abundant on rocks, Vancouver Island.
191. *Mnium drummondii* Bruch & Schimp. Abundant in damp woods, Ontario.
192. *Mnium rostratum* Schwaegr. On damp rocks, Owen Sound, Ontario.
193. *Mnium affine* Bland. Abundant in swamps throughout Ontario.
194. *Mnium insigne* Mitt. Quite common on shady rocks, Vancouver Island.
195. *Mnium hornum* Linn. On rocky soil, Yarmouth, N.S.
196. *Mnium serratum* Laich. Quite common along the Gaspé coast on wet banks of rivers.
197. *Mnium lycopodioides* Schwaegr. On the base of trees in swamps, Ontario.
198. *Mnium spinulosum* Bruch & Schimp. Common on the base of pine trees in woods, throughout Canada.
199. *Mnium stellare* Reich. On rotten stumps in swamps, Ontario.
200. *Mnium punctatum* Hedw. Very common in swamps and by springs, throughout Canada.
201. *Mnium subglobosum* Bruch & Schimp. Peat bogs, Rocky Mountains and British Columbia.
202. *Mnium menziesii* Muell. On earth and rocks, Vancouver Island.
203. [*Mnium cuspidatum* var. *tenellum* Kindb. According to Mrs. Britton's list of accessions.]
204. *Mnium medium* var. *robustum* Kindb. On earth in woods, Vancouver Island.
205. *Conostomum boreale* Sw. Mount Albert, Gaspé, Que., and on Mount Arrowsmith, Vancouver Island.
206. *Cinclidium subrotundum* Lindb. On wet rocks at Becscie River, Anticosti.
207. *Aulacomnium androgynum* Schwaegr. On rocks, Yarmouth, N.S.; abundant, Vancouver Island.
208. *Aulacomnium palustre* Schwaegr. Abundant in bogs and wet woods.
209. *Aulacomnium palustre* var. *imbricatum* Bruch & Schimp. Not uncommon in bogs, Ontario.
210. *Aulacomnium palustre* var. *polycephalum* Bruch & Schimp. Bogs and wet woods, Rocky Mountains.
211. *Aulacomnium heterostichum* Bruch & Schimp. On the base of trees in woods, Ontario.
212. *Timmia megapolitana* Hedw. On the base of trees and rocks in swamps, Ontario.
213. *Timmia austriaca* Hedw. On rocky banks, Vancouver Island.
214. *Atrichum undulatum* Beauv. Abundant by roadsides and in sandy woods, Ontario.
215. *Atrichum angustatum* Bruch & Schimp. On hummocks in sandy woods.
216. *Atrichum selwynii* Aust. On wet slopes in the Rocky Mountains.
217. *Polytrichum (Pogonatum) macounii* Kindb. On the slopes of Mount Arrowsmith, Vancouver Island.
218. *Oligotrichum aligerum* Mitt. On the summits of the higher Rocky Mountains, Bow River Pass.
219. *Pogonatum urnigerum* Beauv. Along the Gaspé Coast and in the Rocky Mountains.
220. *Pogonatum alpinum* Roehl. On rocks in shady places, common.
221. *Polytrichum ohioense* Ren. & Card. Along banks in pine woods, common, Prince Edward Island.
222. *Polytrichum piliferum* Schreb. On dry rocks or sandy barrens, common.
223. *Polytrichum juniperinum* Willd. Very common in pastures and woods.
224. *Polytrichum strictum* Banks. Peat bogs and rocks chiefly in mountains.
225. *Polytrichum commune* L. Peat bogs, not rare in Ontario and Prince Edward Island.
226. *Diphyscium foliosum* Mohr. On earth in pine woods, rare, Prince Edward Island.
227. *Fontinalis antipyretica* L. Abundant in rivers and small brooks.
228. *Fontinalis antipyretica* var. *gigantea* Sull. Abundant in streams, everywhere.
229. *Fontinalis neomexicana* Sull. & Lesq. Nova Scotia Island, in streams.
230. *Fontinalis dalecarlica* Bruch & Schimp. On stones in rivulets, Nova Scotia.
231. *Fontinalis lescurii* Sull. In brooks, Nova Scotia and Ontario.
232. *Fontinalis hypnoides* Hartm. On stone in brooks, Northwest Territories.
233. *Fontinalis kindbergii* Card. In ponds, fruiting after water dries up in June, Vancouver Island.
234. *Dichelyma uncinatum* Mitt. On twigs in ponds and water holes, British Columbia.
235. *Dichelyma pallescens* Bruch & Schimp. On twigs in water holes at Ottawa.

236. *Leptodon trichomitrion* Mohr. On hardwood trees in central Ontario.
237. [*Leucodon sciuroides* Schwaegr., according to Macoun's Catalogue]
238. *Neckera menziesii* Drumm. On rocks, Rocky Mountains; on trees, Vancouver Island.
239. *Neckera pennata* Hedw. On trees, in swamps, Ontario.
240. *Neckera oligocarpa* Bruch & Schimp. On trees and rocks, Rocky Mountains.
241. *Neckera douglasii* Hook. On shaded rocks, Coast Range, and Vancouver Island.
242. *Homalia trichomanoides* Bruch & Schimp. On trees at Ottawa and on rocks, Lake Nipigon.
243. *Homalia obtusata* Mitt. On the base of trees on river banks, British Columbia.
244. *Pterigynandrum filiforme* Hedw. On rocks at Belleville, Ont.; Coast Range, British Columbia.
245. *Antitrichia curtipendula* var. *gigantea* Sull. & Lesq. On trees, Comox, Vancouver Island.
246. *Antitrichia californica* Sull. On trees and rocks near Victoria, Vancouver Island.
247. *Pterygophyllum lucens* Brid. On sticks and earth by ponds, Vancouver Island.
248. *Thelia hirtella* Sull. On small maple trees, Ontario.
249. *Myurella julacea* Bruch & Schimp. On the bases of trees in cedar swamps, Ontario.
250. *Myurella careyana* Sull. In crevices of limestone rocks, Ontario.
251. *Leskea polycarpa* Ehrh. On the base of trees subject to inundation, Ontario.
252. *Leskea nervosa* Myrin. On trunks of trees in woods, Ontario.
253. *Leskea pulvinata* Wah. On bushes and sticks in ponds, British Columbia.
254. *Anomodon rostratus* Schimp. On roots of trees in swamps, Ontario.
255. *Anomodon attenuatus* Schimp. On roots of trees subject to inundation, Ontario.
256. *Anomodon obtusifolius* Bruch & Schimp. On the base of trees, in swamps, Ontario.
257. *Anomodon apiculatus* Bruch & Schimp. On decayed logs at Belleville and Ottawa, Ont.
258. *Anomodon viticulosus* Hook. & Tayl. On limestone rocks, common, Ontario.
259. *Platygyrium repens* var. *orthocladon* Kindb. On old logs, quite common, Ontario.
260. *Pylaisia polyantha* Bruch & Schimp. Abundant on the base of poplar trees, Manitoba.
261. *Pylaisia heteromalla* Bruch & Schimp. On the base of poplar trees, Peace River, Lat. 56°.
262. *Pylaisia intricata* Bruch & Schimp. Very common on trees, old logs and fences, Ontario.
263. *Cylindrothecium cladorrhizans* Schimp. On old logs at Ottawa and Belleville, Ont.
264. *Climacium dendroides* Web. & Mohr. Borders of ponds, Quesnel, B.C.
265. *Climacium americanum* Brid. Shady woods in swamps and wet places at Belleville, Ont.
266. *Orthothecium chryseum* Bruch & Schimp. On moist rocks, Rocky Mountains.
267. *Heterocladium heteropterum* Schimp. On rocks, Nanaimo River, Vancouver Island.
268. *Thuidium minutulum* Hedw. On rotten stumps and logs in woods, Ontario.
269. *Thuidium scitum* Beauv. On beech trunks in woods, Ontario.
270. *Thuidium gracile* Bruch & Schimp. On rotten logs in woods, Ontario.
271. *Thuidium recognitum* Hedw. On earth in shady woods, Ontario.
272. *Thuidium delicatulum* L. On old logs in cedar swamps, Ontario.
273. *Thuidium abietinum* L. On rocks by rivers and lakes, Ontario.
274. *Thuidium blandovii* Web. & Mohr. Peat bogs and cedar swamps, Ontario.
275. *Claopodium crispifolium* Hook. On shaded ground and rocks, Vancouver Island.
276. *Claopodium laxifolium* Schwaegr. On rocks at Cedar Hill, Vancouver Island.
277. *Hypnum* (*Camptothecium*) *lutescens* Huds. On rotten wood, Vancouver Island.
278. *Hypnum* (*Camptothecium*) *nitens* Schreb. Abundant in peat bogs, Ontario.
279. *Hypnum* (*Camptothecium*) *haematidens* Kindb. On the face of perpendicular rocks, Vancouver Island.
280. *Hypnum* (*Camptothecium*) *pinnatifidum* Sull. & Lesq. Abundant on trees and rocks, Vancouver Island.
281. *Hypnum* (*Brachythecium*) *laetum* Brid. Very common on stones and prostrate trunks.
282. *Hypnum* (*Brachythecium*) *acuminatum* Beauv. On decayed trunks subject to inundation, Ontario.
283. *Hypnum* (*Brachythecium*) *salebrosum* Hoffm. On logs and stone in damp woods.
284. *Hypnum (Brachythecium) starkii* Brid. On earth in woods at Owen Sound, Ont.
285. *Hypnum* (*Brachythecium*) *albicans* Neck. var. or n.sp. On sand dunes near the sea at Comox, Vancouver Island.

286. *Hypnum* (*Brachythecium*) *reflexum* Starke. On the base of trees in woods, Owen Sound.
287. *Hypnum* (*Brachythecium*) *rutabulum* L. On stones in woods, Ontario.
288. *Hypnum* (*Brachythecium*) *rivulare* Bruch. On stones in brooks and about springs, Ontario.
289. *Hypnum* (*Brachythecium*) *plumosum* Sw. On stones in shaded woods, Ontario.
290. *Hypnum* (*Scleropodium*) *caespitosum* Wils. On old logs in woods, Vancouver Island.
291. *Hypnum* (*Isothecium*) *myosuroides* L. On trunks in woods, Vancouver Island.
292. [Cited in Macoun's Catalogue as *Isothecium stoloniferum* in part and *I. lentum* in part and in various publications by Grout as *Pseudisothecium* (or *Eurhynchium*) *stoloniferum* in part and *P. stoloniferum* var. *myurellum* in part.]
293. *Hypnum* (*Isothecium*) *spiculiferum* Mitt. On trunks and logs in woods, Vancouver Island.
294. *Hypnum* (*Isothecium*) *brewerianum* Lesq. On rocks and trunks, Vancouver Island.
295. *Hypnum* (*Eurhynchium*) *strigosum* Hoffm. Abundant on earth in woods, Ontario.
296. *Hypnum* (*Eurhynchium*) *sullivantii* Spruce. On limestone rocks, Owen Sound, Ont.
297. *Hypnum* (*Eurhynchium*) *stokesii* Turn. On shaded banks in woods, Vancouver Island.
298. *Hypnum* (*Eurhynchium*) *oreganum* Sull. On logs in woods, Vancouver Island.
299. *Hypnum* (*Raphidostegium*) *recurvans* Schwaegr. On trunks in woods, Ontario.
300. *Hypnum* (*Rhynchostegium*) *deplanatum* Schimp. On stones in woods, Ontario.
301. *Hypnum* (*Rhynchostegium*) *rusciforme* Weis. Not uncommon in running water throughout eastern Canada and Ontario.
302. *Hypnum* (*Thamnium*) *alleghaniense* Muell. Crevices of wet limestone rocks at Owen Sound and Ottawa, Ont.
303. *Hypnum* (*Thamnium*) *bigelovii* Sull. Very abundant on dripping rocks along various rivers on Vancouver Island.
304. *Hypnum* (*Plagiothecium*) *latebricola* Lindb. On the inside of cedar stumps in a swamp at Belleville, Ont. This is Austin's *H. paissaciense* found fruiting at Belleville.
305. *Hypnum* (*Plagiothecium*) *trichophorum* Spruce. On the face of damp rocks on Vancouver Island and throughout British Columbia.
306. *Hypnum* (*Plagiothecium*) *pulchellum* Dicks. On rotten stumps and roots in all parts of Canada, but in small quantity.
307. *Hypnum* (*Plagiothecium*) *pulchellum* var. *nitidulum* James & Lesq. On base of stumps north of Lake Superior and Owen Sound, Ont.
308. *Hypnum* (*Plagiothecium*) *turfaceum* Lindb. Very common on rotten stumps throughout Ontario.
309. *Hypnum* (*Plagiothecium*) *elegans* Hook. Common on rocks and stumps in British Columbia, but rare eastward.
310. *Hypnum* (*Plagiothecium*) *denticulatum* L. On tussocks in swamp and rotten wood and earth in wet woods throughout Canada.
311. *Hypnum* (*Plagiothecium*) *denticulatum* var. *laetum* James & Lesq. On the perpendicular faces of rocks north of Lake Superior.
312. *Hypnum sullivantiae* Schimp. Not rare on rich earth in ravines and deep shady woods throughout Ontario.
313. *Hypnum* (*Plagiothecium*) *sylvaticum* Huds. In dense woods on logs, earth, and rocks. Occasional throughout Canada but nowhere common.
314. *Hypnum* (*Plagiothecium*) *undulatum* L. On the ground in shady, wet woods on Vancouver Island and British Columbia, west of the Coast Range.
315. *Hypnum* (*Amblystegium*) *sprucei* Bruch. On rotten stumps, local but fruiting abundantly in Ontario.
316. *Hypnum* (*Amblystegium*) *subtile* Hoffm. On maple trunks, near the base, Owen Sound and Ottawa, Ont.
317. *Hypnum* (*Amblystegium*) *confervoids* Brid. On flat limestone rocks in damp woods, Ottawa, Belleville, and Owen Sound, Ont.
318. *Hypnum* (*Amblystegium*) *serpens* L. Very common on the ground and on roots of trees in British Columbia but rare in Ontario.
319. *Hypnum* (*Amblystegium*) *porphyrrhizon* Lindb. On the base of trees in damp woods, Belleville and Ottawa, Ont., also Hastings, B.C.

320. *Hypnum* (*Amblystegium*) *varium* Lindb. On stones and logs in running water fruiting in early spring, chiefly eastern.
321. *Hypnum* (*Amblystegium*) *irriguum* Hook. & Wils. On stones and logs in running water in spring, generally dry in summer.
322. *Hypnum* (*Amblystegium*) *adnatum* Hedw. Quite common on stone in shady woods throughout Ontario.
323. *Hypnum* (*Amblystegium*) *adnatum* var. *dentatum* Kindb. On flat stones in woods near Ottawa, October 1885.
324. *Hypnum* (*Amblystegium*) *compactum* Muell. In cushions on the base of small trees in swamps or by brooks, always wet and fruiting abundantly on the Pacific Coast; sterile in Ontario.
325. *Hypnum* (*Amblystegium*) *riparium* L. Abundant on stone, sticks, roots of trees, and decaved stumps, in swamps and stagnant water.
326. *Hypnum* (*Amblystegium*) *riparium* var. *fluitans* James & Lesq. In stagnant and flowing water, Ontario.
327. *Hypnum* (*Campylium*) *hispidulum* Brid. Bases of trees and roots in swampy or moist woods in Quebec, Ontario, and British Columbia.
328. *Hypnum* (*Campylium*) *polygamum* Wils. Not uncommon on the base of trees in dry woods throughout British Columbia.
329. *Hypnum* (*Campylium*) *chrysophyllum* Brid. On limestone rocks, on the ground in wet places and on the bases of trees in swamps throughout Canada.
330. *Hypnum* (*Campylium*) *stellatum* Schreb. Not uncommon in wet, swampy meadows in many districts, chiefly northern.
331. *Hypnum* (*Campylium*) *stellatum* var. *protensum* Bruch & Schimp. In a beaver meadow, Hastings Co. [Ont.], also in the Rocky Mountains at Hector.
332. *Hypnum* (*Harpidium*) *aduncum* Hedw. In swamps and boggy ground where water lies until late summer, Ontario.
333. *Hypnum* (*Harpidium*) *aduncum* var. *kneiffii* Schimp. Stagnant water in Prince Edward Island, New Brunswick, Ontario, and British Columbia.
334. *Hypnum* (*Harpidium*) *sendtneri* Schimp. In Dow's Swamp, Ottawa, Ont.; abundant in a swamp near Hector, Rocky Mountains.
335. *Hypnum* (*Harpidium*) *uncinatum* Hedw. Very common in swampy places throughout Canada, particularly west of the Rocky Mountains.
336. *Hypnum* (*Harpidium*) *fluitans* L. In swamps and peat bogs, Anticosti, Prince Edward Island, and Ontario; also Rocky Mountains.
337. *Hypnum* (*Amblystegium*) *orthocladon* Beauv. On stones in brooks and at riversides in Ontario.
338. *Hypnum* (*Harpidium*) *cossoni* Schimp. In bogs, Anticosti, north shore of Lake Superior and Rocky Mountains.
339. *Hypnum* (*Cratoneuron*) *filicinum* L. Calcareous springs, extending from the Atlantic to the Pacific, very common.
340. *Hypnum* (*Cratoneuron*) *falcatum* Brid. Wet rocks near Hector, Rocky Mountains, also at Kamloops, B.C.
341. *Hypnum* (*Rhytidium*) *rugosum* L. Damp rocks, north shore of Lake Superior; Peace River; Rocky Mountains at Morley.
342. *Hypnum* (*Rhytidium*) *robustum* Hook. Abundant and in fine fruit on Mount Benson, near Nanaimo, Vancouver Island.
343. *Hypnum* (*Ctenium*) *crista-castrensis* L. Very common in damp woods and swamps, on the ground and on logs from the Atlantic to the Pacific.
344. *Hypnum* (*Ctenidium*) *molluscum* Hedw. On stones and logs, Prince Edward Island, and in woods along the Gaspé Coast.
345. *Hypnum reptile* Mx. Very common on the bark of trees near the base, occasionally on logs in shady woods.
346. *Hypnum fertile* Sendtn. On logs and stumps, Prince Edward Island, Nova Scotia, Quebec, and Ontario.
347. *Hypnum circinale* Hook. Quite common on trees, Vancouver Island, and in British Columbia near the coast.

348. *Hypnum imponens* Hedw. Very abundant on decaying logs in damp woods from Ontario eastward.
349. *Hypnum subimponens* Lesq. Very abundant on trees and decaying trunks, Vancouver Island, and the coast district of British Columbia.
350. *Hypnum subimponens* var. *cristula* Kindb. Abundant on rocks in oak woods in the southern part of Vancouver Island. Fruiting in April.
351. *Hypnum cupressiforme* L. On trunks, old logs, and stumps in shady woods in Prince Edward Island and along the Gaspé coast.
352. *Hypnum plicatile* James & Lesq. On rocks at Hector, Rocky Mountains.
353. *Hypnum curvifolium* Hedw. Very common, in large mats, on logs in wet woods or borders of swamps, chiefly eastward.
354. *Hypnum pratense* Koch. On earth by the border of Lake Mara, British Columbia, also by swamps in the Rocky Mountains.
355. *Hypnum haldanianum* Grev. Very abundant in shady woods on decaying logs in Ontario and eastward.
356. *Hypnum* (*Limnobium*) *palustre* Huds. Quite common in alpine and subalpine brooks on stones and rocks, from Nova Scotia to the Pacific.
357. *Hypnum* (*Limnobium*) *dilatatum* Wils. On stones in brooks, Rocky Mountains and Nova Scotia.
358. *Hypnum* (*Limnobium*) *arcticum* Wahl. On rocks and stones in brooks near Halifax, N.S., also in brooks north of Lake Superior.
359. *Hypnum* (*Limnobium*) *obtusifolium* Drumm. Not uncommon in mountain brooks in British Columbia; very common in brooks and rivers on Vancouver Island.
360. *Hypnum* (*Limnobium*) *ochraceum* Turn. Very common in rivulets, north shore of Lake Superior, also in the Rocky and Selkirk Mountains.
361. *Hypnum* (*Calliergon*) *cordifolium* Hedw. In soft places in black ash, elm, and cedar swamps in Ontario, scarce eastward.
362. *Hypnum* (*Calliergon*) *giganteum* Schimp. Abundant and fruiting in swamps, Prince Edward Island, Nova Scotia, Quebec, Ontario, and British Columbia.
363. *Hypnum* (*Calliergon*) *sarmentosum* Wahl. Peat bogs near Salt Lake, Anticosti.
364. *Hypnum* (*Calliergon*) *schreberi* Willd. Very common on the ground in fir woods throughout Canada.
365. *Hypnum* (*Calliergon*) *trifarium* Web. & Mohr. Shore of Lake Huron, Bruce, Ont.; peat bog, northern British Columbia.
366. *Hypnum* (*Scorpidium*) *scorpioides* L. On mud along the borders of ponds and lakelets in deep woods, Nova Scotia and Ontario.
367. *Hypnum* (*Pleurozium*) *splendens* Hedw. Very common in deep, shady woods and swamps throughout Canada.
368. *Hypnum* (*Pleurozium*) *umbratum* Ehrh. On the sides of ravines, Pirate's Cove and Truro, N.S.
369. *Hypnum* (*Pleurozium*) *oakesii* Sull. On old logs in woods at Owen Sound, Ont.
370. *Hypnum* (*Hylocomium*) *squarrosum* L. Grassy places on Anticosti; common along the overflowed margins of streams in British Columbia.
371. *Hypnum* (*Hylocomium*) *triquetrum* L. Very common in damp woods and swamps throughout Canada.
372. *Hypnum* (*Hylocomium*) *loreum* L. On McNab's Island, Halifax Harbor, N.S.; very abundant on the Pacific Coast and Vancouver Island.
373. *Hypnum* (*Pleurozium*) *brevirostre* Ehrh. On rocks in ravines, Pirate's Cove, N.S., Quebec, and British Columbia.
374. *Hypnum* (*Harpidium*) *uncinatum* var. *plumosum* Schimp. In swamps, Prince Edward Island; Hector, Rocky Mountains.
375. *Hypnum* (*Harpidium*) *renauldi* Kindb. Along a swamp, on earth, at Hunter River, P.E.I.
376. *Hypnum* (*Harpidium*) *uncinatum* var. *subestriatum* Kindb. In bogs near Brackley Point, P.E.I., 1888.
377. *Pogonatum capillare* Brid. Clay banks, Gaspé Coast; in similar places, Brackley Point, P.E.I.
378. *Hypnum* (*Calliergon*) *richardsonii* James & Lesq. Wet boggy ground north of Lake Superior, also at Hunter River, P.E.I.

379. *Hypnum* (*Brachythecium*) *velutinum* L. On earth at base of trees, Belleville, Ont.; in similar places, Brackley Point, P.E.I., 1888.
380. *Hypnum* (*Brachythecium*) *oedipodium* Mitt. On rotten logs in wet woods, Brackley Point, P.E.I.
381. *Bryum inclinatum* Bruch & Schimp. Quite common on sandy soil, Brackley Point, P.E.I., 1888.
382. *Hypnum* (*Harpidium*) *exannulatum* Gümb. Very common in "water holes" and marshes, Prince Edward Island; also in bogs, British Columbia, 1889.
383. *Bryum warneum* Bland. Abundant on the consolidated sands of Brackley Point, P.E.I., 1888.
384. *Hypnum* (*Harpidium*) *vernicosum* Lindb. Common in bogs in the Rocky Mountains, at the summit of the Canadian Pacific Railway, 1885.
385. *Hypnum* (*Calliergon*) *cuspidatum* L. Swampy roadside, Comox, Vancouver Island; wet meadow, East Cape, P.E.I., 1888.
386. *Leptotrichum vaginans* James & Lesq. Quite common on clay by roadsides, Prince Edward Island.
387. *Hypnum* (*Harpidium*) *revolvens* Sw. Cold, springy bogs in the Rocky Mountains, near Hector.
388. *Scouleria aquatica* var. *nigrescens* Kindb. Abundant in mountain brooks Vancouver Island and throughout British Columbia.
389. *Neckera douglasii* var. *macounii* Kindb. Hanging from small trees in damp woods, Vancouver Island and British Columbia and [at?] Hastings.
390. *Bryum occidentale* Sull. Common in meadows and prairies at Morley, Rocky Mountains.
391. *Dichelyma longinerve* Kindb. Abundant in dried-up ponds on the roots of trees and dead sticks, Cedar Hill, Vancouver Island, 1887.
392. *Hypnum* (*Camptothecium*) *hamatidens* [sic] Kindb. Abundant on steep faces of rocks, Vancouver Island and British Columbia.
393. *Hypnum hamulosum* Bruch & Schimp. On the base of trees and dead logs, Salt Lake, Anticosti.
394. *Hypnum* (*Isothecium*) *cardoti* Kindb. On roots and trunks of trees, Vancouver Island and Fraser River valley, B.C.
395. *Leskea nigrescens* Kindb. Abundant on flat limestone rocks, Beechwood, near Ottawa, Ont.
396. *Hypnum* (*Limnobium*) *alpestre* Sw. On rocks in brooks, near Halifax, N.S.; Selkirk Mountains at Glacier Creek, B.C.
397. *Hypnum* (*Isothecium*) *myurcellum* [sic] Kindb. On trunks at Victoria and Comox, Vancouver Island.
398. *Hypnum* (*Brachythecium*) *collinum* Schleich. On dry gravel banks, Cypress Hills, Bow River Pass, and Selkirk Mountains, B.C.
399. *Barbula flexifolia* Hampe. On damp earth by the sea, Oak Bay, Vancouver Island; also by streams, Yale, B.C.
400. *Fissidens decipiens* DeNot. On the base of rotten stumps and rotten logs in swamps at Owen Sound and Ottawa, Ont.
401. *Andreaea macounii* Kindb. On flat rocks, alt. 6500 ft., higher slopes of mountains north of Griffin Lake, Gold Range, B.C., 1889.
402. *Dichodontium flavescens* Lindb. On boggy ground, Hunter River, P.E.I.; abundant and fruiting, Hastings, B.C.
403. *Dicranella schreberi* Schimp. Abundant on earth along a brook, Trenton, Ont.; also in a spring, Lake Mara, Sicamous, B.C., 1889.
404. *Dicranum albicans* Bruch & Schimp. Crevices of rocks, alt. 7000 ft., summit of mountains north of Griffin Lake, Gold Range, B.C., 1889.
405. *Dicranum angustifolium* Kindb. On rocks and ground, north arm of Burrard Inlet and Gold Range, B.C., 1889.
406. *Dicranum sulcatum* Kindb. On earth in wet woods, Vancouver Island and British Columbia.
407. *Dicranum scoparium* var. *orthophyllum* Kindb. On rotten logs in the southern part of Vancouver Island.

408. *Dicranum congestum* Brid. Occasional on the ground in woods in Ontario, British Columbia, and the Rocky Mountains.
409. *Dicranum palustre* La Pyl. Swamps near Colborne, Ont.; near Victoria, Vancouver Island, and Burrard Inlet, B.C., April 16, 1889.
410. *Fissidens tamarindifolius* Brid. On the bases of trees subject to inundation, near the mouth of Eagle River, Sicamous, B.C., July 4, 1889.
411. *Trichodon cylindricus* Schimp. Very abundant on damp earth, Hastings, Burrard Inlet, B.C., 1889.
412. *Barbula rigidula* Schimp. On rocks on the borders of a mountain brook, Lytton, B.C., 1889.
413. *Barbula angustata* Wils. On earth of brooks, Morley, Rocky Mountains; also Vancouver Island near Victoria and Lytton and Spence's Bridge, B.C.
414. *Grimmia alpestris* Schleich. On dry rocks on the upper slopes of mountains south of Spence's Bridge; also north of Griffin Lake, B.C., 1889.
415. *Grimmia nivalis* Kindb. On sloping rocks, alt. 6500 ft., summit of Gold Range, B.C., Aug. 1889.
416. *Racomitrium fasciculare* Brid. On rocks by the sea, Hastings, Burrard Inlet, B.C., 1889.
417. *Racomitrium canescens* var. *ericoides* Bruch & Schimp. Abundant on rocks, Vancouver Island and British Columbia.
418. *Racomitrium macounii* Kindb. On rocks, near Hector, Rocky Mountains; also on the Gold Range north of Griffin Lake, B.C., 1889.
419. *Racomitrium obscurum* Kindb. On rocks, 5500 ft. alt., Mount Arrowsmith, Vancouver Island; also on the Gold Range north of Griffin Lake, B.C., 1889.
420. *Amphoridium mougeotii* Schimp. On damp rocks, Mt. Benson, Vancouver Island; frequent in similar places in British Columbia.
421. *Encalypta spathulata* Muell. On dry rocks on hillsides, Lytton, B.C., April 1889.
422. *Tetraphis geniculata* Girg. On old stumps and rotten logs, Hastings and Craigallachie, B.C., July 1889.
423. *Webera commutata* Schimp. On the summit of the Gold Range, alt. 7000 ft., north of Griffin Lake, B.C., 1889.
424. *Webera gracilis* (Schleich.) Kindb. Summit of Mount Albert, Gaspé; summit of Gold Range, alt. 6500 ft., north of Griffin Lake, B.C., Aug. 1889.
425. *Bryum concinnatum* Spruce. Close to perpetual snow, alt. 7000 ft., summit of Gold Range, north of Griffin Lake, B.C., Aug. 1889.
426. *Atrichum parallelum* Mitt. On mountains west of Lesser Slave Lake, 1872; also at alt. 6000 ft., Gold Range north of Griffin Lake, B.C., Aug. 1889.
427. *Pogonatum alpinum* var. *septentrionale* Brid. Alt. 7500 ft., summit of Copper Mountain, Rocky Mountains; also at alt. 7000 ft., Gold Range north of Griffin Lake, B.C., Aug. 1889.
428. *Polytrichum sexangulare* Floerke. Selkirk Mountains and close to permanent snow, alt. 7000 ft., summit of Gold Range, north of Griffin Lake, B.C., Aug. 1889.
429. *Polytrichum formosum* Hedw. On stumps and roots of decaying Douglas Fir at Hastings, B.C., April 1889.
430. *Pogonatum contortum* Lesq. On earth by a ditch, near Comox, Vancouver Island, also at Hastings, B.C., 1889.
431. *Dichelyma capillaceum* Bruch & Schimp. Abundant on sticks by ponds, Canaan Forks, Queen's Co., N.B. (coll. J. Moser).
432. [distributed as *Fontinalis tenella*, according to Macoun's Catalogue.]
433. *Thelia compacta* Kindb. Forming compact rings on small maples about 4 ft. from the ground, Seymour, Northumberland Co., Ont.
434. *Pylaisia selwynii* Kindb. Abundant and fruiting on old cedar rails along Richmond Road west of Ottawa, 1884.
435. *Homalothecium pseudosericeum* Lesq. & James. On rocks, Agassiz and Yale, B.C., 1889.
436. *Cylindrothecium drummondii* Bruch & Schimp. On hummocks in the "Big Swamp," Murray, Northumberland Co., Ont.
437. *Hypnum* (*Pseudoleskea*) *atrovirens* Dicks. Abundant on rocks, Gold Range, north of Griffin Lake, B.C., Aug. 1889.

438. *Hypnum* (*Brachythecium*) *acutum* Mitt. On rocks in woods around Ottawa, Ont., 1891.
439. *Hypnum* (*Camptothecium*) *megaptilum* Sull. On the base of old stumps near the sea, Hastings, B.C., April 1889.
440. *Hypnum* (*Brachythecium*) *novae-angliae* Sull. & Lesq. On earth in woods, Canaan Forks, Queen's Co., N.B.
441. *Hypnum* (*Brachythecium*) *populeum* Hedw. Quite common on boulders and other rocks, Gilmour's Park, Chelsea, Que.
442. *Hypnum* (*Eurhynchium*) *hians* Hedw.? On stones and earth in a ravine, Hastings, Burrard Inlet, B.C.
443. *Hypnum* (*Raphidostegium*) *demissum* Wils. On damp rocks in ravines, Hastings, B.C., and Brighton, Northumberland Co., Ont.
444. *Hypnum* (*Raphidostegium*) *roellii* Ren. & Card. On rotten logs, Agassiz, B.C., 1889.
445. *Hypnum* (*Thamnium*) *neckeroides* Hook. var. On damp rocks, Agassiz and Yale, B.C., 1889.
446. *Hypnum* (*Amblystegium*)*fluviatile* Sw. On stones in brooks, Ottawa, Owen Sound, and Lake Superior.
447. *Hypnum* (*Harpidium*) *aduncum* var. *gracilescens* Bruch & Schimp. In a limestone spring, Lake Mara, Sicamous, B.C., 1889.
448. *Hypnum* (*Cratoneuron*) *commutatum* Hedw. On wet rocks in a mountain brook, Lytton, B.C., April 1889.
449. *Hypnum* (*Eurhynchium*) *substrigosum* Kindb. On earth in woods, Hastings, B.C.; also in damp woods, Ottawa, Ont., 1889.
450. *Hypnum* (*Hylocomium*) *squarrosum* var. *calvescens* Wils. On earth and sand by the sea, Pirate's Cove, N.S.; also at Hastings, Burrard Inlet, B.C.
451. *Dichodontium pellucidum* Schimp. On wet gravel in beds of streams, Prince Edward Island; also on stones in Eagle River below Griffin Lake, B.C., 1889.
452. *Fissidens minutulus* Sull. Very abundant on smooth, moist limestone rocks, McKay's Woods, Ottawa.
453. *Ulota bruchii* Hornsch. Abundant on small trees in thickets, Westminster Junction, B.C., 1889.
454. *Orthotrichum laevigatum* Zett. Very abundant on dry rocks, Lytton, B.C., 1889.
455. *Orthotrichum venturi* Kindb. On Laurentian boulders, Belleville, Ont., Oct. 1888.
456. *Hypnum* (*Rhynchostegium*) *serrulatum* Hedw. On earth in woods around Ottawa, Ont., 1889.
457. *Bryum vancouveriense* Kindb. By the borders of ditches, Cedar Hill, near Victoria, Vancouver Island, 1887.
458. *Bryum subrotundum* Brid. On mountain slopes, by brooks, Lytton, B.C., 1889.
459. *Merceya latifolia* Kindb. On dripping rocks, Mount Finlayson, Goldstream, Vancouver Island, 1887.
460. *Pseudoleskea catenulata* Bruch & Schimp. On dry rocks on mountain slopes, Spence's Bridge, B.C., May 1889.
461. *Leptotrichum flexicaule* var. *densum* Schimp. On shaded, damp rocks at Donald, Columbia Valley, and on Mount Benson, Vancouver Island.
462. *Alsia macounii* Kindb. On rocks, Cedar Hill, Vancouver Island, and Yale, B.C., May 17, 1889.
463. *Atrichum xanthopelma* Lesq. & James. Under a clay bank, south side of the Canadian Pacific Railway, Craigallachie, Gold Range, B.C., July 18, 1889.
464. *Orthotrichum lyellii* var. *papillosum* Lesq. & James. Abundant on trees, Cedar Hill and Comox, Vancouver Island, May 1887.
465. *Ephemerum serratum* var. *minutissimum* Schimp. Abundant in woods subject to overflow in spring, Leamy's Lake, Ottawa.
466. *Hypnum* (*Amblystegium*) *zuratzkae* Schimp. On stones and dead wood under trees in woods, Ottawa, Ont., 1889.
467. *Racomitrium canescens* var. *muticum* Kindb. On rocks alt. 6500 ft. mountains north of Griffin Lake, Gold Range, B.C., 1889.
468. *Webera cucullata* Schimp. Alt. 6500 ft., Mountains north of Griffin Lake, Gold Range, B.C., 1889.
469. *Platygyrium rupestre* Kindb. On rocks, Yale, B.C., 1889.

470. *Pylaisia velutina* Bruch & Schimp. On the bark of cedars in swamps and on old logs in woods, Ottawa, Ont., 1889.
471. *Mnium orthorhynchum* Bruch & Schimp. Crevices of limestone rocks, Niagara Falls, 1882, and on ledges, McKay's Lake, Ottawa, Ont., 1889.
472. *Grimmia calyptrata* Hook. On rocks at Spence's Bridge, 1889, and Deer Park, Arrow Lake, Columbia River, B.C., June 11, 1890.
473. *Hypnum* (*Calliergon*) *stramineum* Dicks. In peat bogs, Anticosti, and in bogs, Roger's Pass, Selkirk Mountains, B.C., Aug. 1890.
474. *Encalypta longipes* Mitt. On clay banks along the mountain stream that enters Kicking Horse Lake at the C.P.R. station, Rocky Mountains, 1890.
475. *Dicranella squarrosa* Schimp. On wet, gravelly soil along the Canadian Pacific Railway, Roger's Pass, Selkirk Mountains, B.C., 1890.
476. *Dicranella cerviculata* Schimp. On silt washed from a glacier near the C.P.R. station, Roger's Pass, Selkirk Mountains, B.C., 1890.
477. *Dicranoweisia crispula* Lindb. In small cushions on boulders and logs in the Selkirk and Rocky Mountains, B.C., 1885.
478. [Cited in Macoun's Catalogue as *Polytrichum gracile* Menz.]
479. *Barbula aciphylla* B.S.G. On rocks, Gold Range and Selkirk Mountains, B.C., 1889 and 1899.
480. *Bryum rauii* Aust. In bed of brook, face of mountain west of Columbia River at Revelstoke, B.C., May 30, 1890.
481. *Dicranum muehlenbeckii* Bruch & Schimp. On loose rocks in the Selkirk and Rocky Mountains, B.C., Aug. 15, 1890.
482. *Dicranella grevilleana* Schimp. On wet, gravelly soil along the Canadian Pacific Railway, Hector, Rocky Mountains, 1890.
483. *Hypnum* (*Calliergon*) *turgescens* Schimp. Abundant on marshy ground at the head of Kicking Horse Lake and in mountain brooks near perpetual snow, alt. 7500 ft., Aug. 1890.
484. *Heterocladium homoeopterum* Muell. & Kindb. Abundant on wet rocks along the Columbia River above Revelstoke, B.C., May 1890.
485. *Racomitrium nevii* Wats. Abundant on damp faces of perpendicular rocks, Eagle Pass near Revelstoke, B.C., 1890.
486. *Leptotrichum tenue* Muell. & Kindb. On sandy soil along the Canadian Pacific Railway, Revelstoke, B.C., May 23, 1890.
487. *Bryum lato-decurrens* Muell. & Kindb. In boggy places and ditches, Revelstoke, B.C., May 12, 1890. Quite common and often very red.
488. *Cynodontium virens* var. *serratum* Bruch & Schimp. In small patches along brooks in mountains of British Columbia, 1889.
489. *Lescuraea imperfecta* Muell. & Kindb. On rotten trunks and small trees in woods, west side of Columbia River at Revelstoke, B.C., May 9, 1890.
490. *Distichium macounii* Muell. & Kindb. In small tufts among other mosses, along Columbia River above Revelstoke, B.C., May 18, 1890.
491. *Encalypta cucullata* Muell. & Kindb. On earth in crevices of rocks along Columbia River at Revelstoke, B.C., May 9, 1890.
492. *Hypnum* (*Brachythecium*) *rivulare* var. *new-brunswickae* Kindb. In boggy places above Railway Station, Revelstoke, B.C., 1890.
493. *Hypnum* (*Limnobium*) *columbico-palustre* Muell. & Kindb. Crevices of wet rocks close to water at mouth of the canyon, Revelstoke, B.C., May 18, 1890.
494. *Hypnum depressulum* Muell. On flat rocks along the Canadian Pacific Railway from Hector to Field, Rocky Mountains, 1890.
495. *Dicranella schreberi* var. *occidentalis* Aust. On wet gravel along the Canadian Pacific Railway 3 miles west of Hector, Rocky Mountains, B.C., 1890.
496. *Homalothecium sericeoides* C. M. & Kindb. Quite common on the face of dry rocks and in crevices in thick mats, Revelstoke, B.C., May 7, 1890.
497. *Orthotrichum lonchothecium* Muell. & Kindb. Quite common on metamorphic rocks, Deer Park, Lower Arrow Lake, Columbia River, B.C., June 4, 1890.
498. *Heterocladium procurrens* Lesq. & James. On stones on mountain slopes, alt. 4500 ft., Roger's Pass, Selkirk Mountains, Aug. 7, 1890.

499. *Racomitrium affine* (Schleich.) Lindb. Abundant on stones, base of Avalanche Mountain, summit of Roger's Pass, Selkirk Mountains, 1890.
500. *Hypnum* (*Eurhynchium*) *diversifolium* Schimp. On earth and rock at base of cliffs, Deer Park, Lower Arrow Lake, Columbia River, B.C., June 6, 1890.
501. *Grimmia* (*Eugrimmia*) *tenella* Muell. On the perpendicular faces of rocks, Deer Park, Lower Arrow Lake, Columbia River, B.C., June 11, 1890.
502. *Bryum blindii* Bruch & Schimp. On wet gravel along the Canadian Pacific Railway where it crosses the eastern branch of the Kicking Horse River at Hector, Rocky Mountains, Aug. 1890.
503. *Hypnum* (*Limnobium*) *goulardii* Schimp. On rocks in Becscie River, Anticosti, and in the bed of mountain brooks at Hector, Rocky Mountains, Aug. 1890.
504. *Dicranella crispa* Schimp. On loamy soil on roots of turned-up trees, Selkirk and Rocky Mountains, B.C., 1885.
505. *Bryum percumcentinerve* Kindb. On the face of a waterfall in a brook west of Kamloops, B.C., June 1890.
506. *Gymnostomum platyphyllum* Kindb. On face of waterfall in brook west of Kamloops, B.C., June 18, 1889.
507. *Hypnum* (*Eurhynchium*) *semiasperum* Muell. & Kindb. On damp logs near brook, Deer Park, Lower Arrow Lake, Columbia River, B.C., June 6, 1890.
508. *Fabronia pusilla* Raddi. In crevices of rocks, Deer Park, Arrow Lake, Columbia River, B.C., June 6, 1890.
509. *Grimmia montana* Bruch & Schimp. In small, compact tufts on metamorphic rocks, Deer Park, Lower Arrow Lake, Columbia River, B.C., June 9, 1890.
510. *Pseudoleskea falcicuspis* Muell. & Kindb. On rocks at the mouth of Illicillewaet Canyon, near Revelstoke, B.C., May 18, 1890.
511. *Grimmia plagiopodia* var. *brandegei* Aust. On exposed boulders along Patterson's Creek, near railway station, Kamloops, B.C., May 26, 1890.
512. *Barbula* (*Tortella*) *inclinatula* Muell. & Kindb. On gravel bars in the old bed of the Illicillewaet, near Revelstoke, B.C., May 22, 1890.
513. *Bryum synoico-caespiticium* Muell. & Kindb. Abundant on wet gravel and silt in closed-up channels of the Illicillewaet at Revelstoke, B.C., May 27, 1890.
514. *Hypnum* (*Campylium*) *decursivulum* Muell. & Kindb. In boggy ground on sticks and logs under the railway bridge east of Albert Canyon Station, Selkirk Mountains, May 29, 1890.
515. *Weissia viridula* Brid. Abundant on hummocks in woods by Leamy's Lake, near Hull, Que., 1889. Also distributed as *Weissia viridula* Brid. On the ground in open woods at Leamy's Lake, near Ottawa, Oct. 1889.
516. *Mnium schleicheri* Schwaegr. Mount Aylmer, alt. 8500 ft., Rocky Mountains, Aug. 6, 1891.
517. *Mnium decurrens* Muell. & Kindb. Abundant on rocks in mountain brook along Columbia River, above Revelstoke, B.C., July 24, 1890.
518. *Cynodontium strumulosum* Muell. & Kindb. On limestone ledge by torrent at Hector Station, Rocky Mountains, Aug. 13, 1890.
519. *Bryum rubicundum* Muell. & Kindb. On earth along creek that discharges the Asulcan Glacier, Selkirk Mountains, Aug. 7, 1890.
520. *Mnium umbratile* Mitt. Abundant on stones and earth by mountain brooks along the Columbia, above Revelstoke, B.C., 1890.
521. *Webera acuminata* Schimp. In crevices of wet rocks at waterfall near the "Great Glacier," Selkirk Mountains, Aug. 8, 1890.
522. *Hypnum* (*Campylium*) *macounii* Kindb. Quite common in thin mats on rocks, Kicking Horse Pass, Hector, B.C., 1885 and 1890. [Number was printed as 533 but altered by hand to 522.]
523. *Ulota obtusiuscula* Muell. & Kindb. On the stems of small trees in thickets at Westminster Junction [along the Coquilla River], B.C., April 26, 1888.
524. *Racomitrium alternatum* Muell. & Kindb. On rocks along the Canadian Pacific Railway, summit of Roger's Pass, Selkirk Mountains, Aug. 6, 1890. [Cited elsewhere as "*alternuatum*" (by Macoun) and "*attenuatum*" (by Kindberg).]
525. *Drummondia clavellata* Hook. On the trunks of trees in woods, Owen Sound and Port

Dover, Ont. [Printed as 526, altered by hand to 525.]
526. *Sphagnum riparium* Ångstr. In boggy spots, Roger's Pass, B.C., July 31, 1890.
527. *Sphagnum fimbriatum* Wils. Bog at the Racecourse, Ottawa, Ont., Oct. 10, 1890.
528. *Sphagnum recurvum* var. *parvifolium* Warnst. Peat bog, Hastings Co., and Mer Bleue, near Ottawa, Ont.
529. *Sphagnum recurvum* var. *mucronatum* Russ. Peat bog, Mer Bleue, near Ottawa, Oct. 4, 1890.
530. *Sphagnum recurvum* var. *pulchrum* Lindb. Wet woods, Mer Bleue, near Ottawa, Oct. 4, 1890.
531. *Sphagnum fuscum* var. *fuscescens* Warnst. Peat bogs, Mer Bleue, near Ottawa, Oct. 4, 1890.
532. *Sphagnum girgensohnii* var. *hygrophilum* Warnst. In boggy woods north of Beechwood, Ottawa, Oct. 14, 1890.
533. *Leskea subobtusifolia* Muell. & Kindb. On trees subject to inundation, Pass Creek, B.C., June 18, 1890.
534. *Dichelyma obtusulum* Kindb. On dead sticks in water, Bass River, N.B., Prof. J. Fowler, July 13, 1878.
535. *Hypnum eugyrium* Schimp. On stones in a ravine, Banff, Rocky Mountains, July 22, 1891.
536. *Bryum pseudotriquetrum* Schwaegr. var. Bogs, Roger's Park [Pass], Selkirk Mountains, B.C., July 31, 1890.
537. *Dicranum spadiceum* Zett. On rocks, alt. 8000 ft., Mount Niblock, Rocky Mountains, Aug. 19 (or possibly 10). [No year indicated.]
538. *Bryum cyclophyllum* Bruch & Schimp. On stones, Banff, Rocky Mountains, July 11, 1891.
539. *Hypnum pseudo-montanum* Muell. & Kindb. On stones in bed of Sydenham River, below Jones' Falls and below the Pottowatimie Falls, Owen Sound, Sept. 16, 1890. [Original number 527, altered in Macoun's hand to 539 in Lawson's set, and the specimen was cited under no. 539 in Macoun's Catalogue.]
540. *Atrichum crispum* James. On earth in woods, Port Dover, Ont., Sept. 24, 1890.
541. *Amblystegium minutissimum* Sull. & Lesq. On rocks, Lake Louise, Rocky Mountains, Aug. 20, 1891.
542. *Barbula horridifolia* Muell. & Kindb. On damp rocks, Revelstoke, B.C., May 9, 1890.
543. *Bryum leucolomatum* Muell. & Kindb. In small marsh, Revelstoke, B.C., May 17, 1890.
544. *Pogonatum dentatum* Brid. On clay banks, Roger's Pass, B.C., July 31, 1890.
545. *Hypnum decipiens* (DeNot.) Kindb. On stones in brooks, Roger's Pass, B.C., July 30, 1890.
546. *Pogonatum macounii* Kindb. On rocks and earth, Roger's Pass, B.C., July 25, 1890.
547. *Barbula papillinervis* Muell. & Kindb. Revelstoke, B.C., May 23, 1890. [The only specimen seen was in Lawson's set, with a handwritten label bearing a printed heading "Canadian Musci."]
548. *Brachythecium nanopes* Muell. & Kindb. On earth, Revelstoke, B.C., May 19, 1890.
549. *Homalothecium sericeum* (L.) BSG. On dry rocks, Banff, Rocky Mountains, Aug. 10, 1891.
550. *Leptotrichum flexicaule* var. *brevifolium* Kindb. On rocks, Devil's Lake, Rocky Mountains, Aug. 10, 1891.
551. *Mnium inclinatum* Lindb. In crevices of rocks at Ottawa, Owen Sound, and the Rocky Mountains. [Number printed as 529 but (in some sets) altered to 551, the number cited in Macoun's Catalogue.]
552. *Dichodontium pellucidum* var. *fagimontanum* Braithw. In mud by brook, Hector, Rocky Mountains, Aug. 14, 1890. Also distributed as *Dichodontium pellucidum* var. *fragi-montanum* [sic] Kindb. On wet rocks along stream entering Kicking Horse Lake at Hector, B.C., Aug. 15, 1890. [The number of the latter was printed as 531 but altered by hand to 552.]
553. *Pterigynandrum papillosulum* Muell. & Kindb. On dry rocks, Deer Park, B.C., June 4, 1890.
554. *Bryum oligocladon* Muell. & Kindb. On dry rocks, Deer Park, Lower Arrow Lake,

Columbia River, B.C., June 12, 1890. [In some sets the label was printed as 522, in others as 528, both altered by hand to read 554.]

555. *Bryum haematocarpum* Muell. & Kindb. On earth in valley of Pass Creek at Sproat, Columbia River, June 19, 1890. [Number printed as 532, altered by hand to 555.]
556. *Dicranum congestiforme* Muell. & Kindb. On damp rocks, Sicamous, B.C., July 3, 1889.
557. *Ulota connectens* Kindb. On cedar trees, Dow's Swamp, Ottawa, Oct. 1889.
558. *Scouleria muelleri* Kindb. On boulders in the Columbia River, Revelstoke, B.C., May 12, 1892.
559. *Pottia heimioides* Kindb. On earth, Banff, Rocky Mountains, July 4, 1891.
560. *Gymnostomum calcareum* Nees & Hornsch. On calcareous rocks, Owen Sound, Ont., Sept. 13, 1890.
561. *Dicranum subpalustre* Muell. & Kindb. On rocks, Deer Park, Columbia River, B.C., June 3, 1890.
562. *Aulacomnium palustre* var. *laxifolium* Kindb. On earth, boggy soil, Roger's Pass, B.C., Aug. 7, 1890.
563. *Polytrichum commune* var. *canadense* Kindb. On earth in railway cutting, Albert Canyon, B.C., May 29, 1890.
564. *Pseudoleskea sciuroides* var. *denudata* Kindb. On rocks, alt. 6000 ft., Asulcan Creek, B.C., Aug. 7, 1890.
565. *Encalypta procera* Bruch. On wet rocks, Hector, Rocky Mountains, B.C., Aug. 11, 1890.
566. *Brachythecium spurio-acuminata* [sic] Muell. & Kindb. On old logs and the base of trees in woods at Brighton, Northumberland Co., Ont., Oct. 6, 1888. [In Lawson's collection, originally 525, altered by Macoun to read 566.]
567. *Neckera menziesii* var. *amblyclada* Kindb. On rocks, Hector, Rocky Mountains, B.C., July 15, 1885.
568. *Rhabdoweisia fugax* Bruch & Schimp. On limestone rocks on the face of escarpments around Owen Sound; very abundant. [In Lawson's set printed as 525, altered by Macoun to 568.]
569. *Dicranum crispulum* Muell. & Kindb. In woods, Albert Canyon, Selkirk Mountains, B.C., May 29, 1890.
570. *Dicranum leucobasis* Muell. & Kindb. On the bases of trees, Roger's Pass, B.C., July 29, 1890.
571. *Hypnum pallescens* Schimp. On limestone rocks, near Hull, Que., Oct. 24, 1891.
572. *Sphagnum warnstorfii* var. *viride* Warnst. Peat bog, Sundance Creek, Banff, Rocky Mountains.
573. *Sphagnum warnstorfii* var. *purpurascens* Russ. Peat bog, Sundance Creek, Banff, Rocky Mountains, July 25, 1891.
574. *Sphagnum lindbergii* Schimp. Peat bogs, Newfoundland, *Rev. A. Waghorne*, 1891.
575. *Sphagnum imbricatum* var. *cristatum* Warnst. Peat bogs, Louisburg, cape Breton, July 1883.
576. *Sphagnum acutifolium* var. *rubrum* Warnst. Peat bogs, Newfoundland, *Rev. A. Waghorne*.
577. *Pottia heimii* Fürnr. On earth, St. Matthew Island, Bering Sea, *J. M. Macoun*, Aug. 1891.
578. *Philonotis glabriuscula* Kindb. By springs in a gully, Queen's Co., N.B., *J. Moser*, Jan. 2, 1890.
579. *Ceratodon heterophylla* Kindb. On earth, St. Paul Island, Bering Sea, *J. M. Macoun*, Aug. 8, 1891.
580. *Pseudoleskea stenophylla* Ren. & Card. On alders and stones, Roger's Pass, B.C., Aug. 5, 1890.
581. *Mnium niagarae* Kindb. On earth in woods, Whirlpool, Niagara Falls, June 6, 1891.
582. *Ulota camptopoda* Kindb. On trees, Aylmer Road, Hull, Que., *J. M. Macoun*, April 24, 1891.
583. *Orthotrichum cupulatum* Hoffm. On dry rocks, Rocky Mountains, 1885; also on mountains at Spence's Bridge and Kamloops, B.C., 1889. [In Lawson's set the printed 469 was changed by Macoun to read 583.]

584. *Hypnum canadense* Kindb. On stones in woods, McNab Island, Halifax, N.S., June 19, 1883.
585. *Orthotrichum sturmii* Hoppe & Hornsch. On rocks, Deer Park, Columbia River, B.C., June 4, 1890.
586. *Timmia norvegica* Zett. On rocks and earth, Hector, Rocky Mountains, Aug. 10, 1891.
587. *Hypnum filicinum* var. *aciculinum* Muell. & Kindb. On dripping rocks, Revelstoke, B.C., May 23, 1890.
588. *Dicranum brevifolium* Lindb. On rocks, Lake Louise, Rocky Mountains, Aug. 18, 1891.
589. *Dicranum albicans* var. *denticulatum* Kindb. On rocks, near Hector, Rocky Mountains, B.C., Aug. 7, 1890.
590. *Hypnum unicostatum* Muell. & Kindb. In Mer Bleue, Ottawa, Ont., Oct. 4, 1890.
591. *Brachythecium leucoglaucum* Muell. & Kindb. On loose earth, Queen's Co., N. B., *J. Moser*, Sept. 10, 1888.
592. *Dicranum elongatum* Schwaegr. On earth, Devil's Lake, Rocky Mountains, Aug. 3, 1891.
593. *Bryum subpurpurascens* Kindb. On wet earth, Port Moody, Burrard Inlet, B.C., April 23, 1889.
594. *Sphagnum garberi* Lesq. & James. Peat bogs, Newfoundland, *Rev. A. Waghorne*, 1891.
595. *Sphagnum papillosum* Lindb. In bogs, New Harbor, Newfoundland, *Rev. A. Waghorne*, July 7, 1891.
596. *Leucodon brachypus* Brid. On trunks of trees in thick woods, Owen Sound, Ont., 1890.
597. *Physcomitrium pyriforme* Brid. On earth by roadsides, Windsor and Sandwich, Ont., May 24, 1892. [An inner packet was originally numbered 598 but changed to 597. Macoun wrote Mrs. Britton, on March 4, 1893, that some specimens under no. 597 may be "a variety of *Tortula ruralis* collected at Colborne, Lake Erie," and, on Feb. 28, he told her to discard her specimen of 597 and to change 598 to 597: "Put the enclosed specimen for 598. You will see that it is a new species of *Mnium*." I have seen several specimens of 597 correctly named *Physcomitrium* and one that is indeed a *Tortula*. The only specimens of 598 seen were *Mnium*, as the label indicates.]
598. *Mnium glabrescens* Kindb. In damp places, Hastings, Burrard Inlet, April 24, 1889.
599. *Thelia asprella* Sull. On bases of trees, south end of Pelee Point, Lake Erie, Ont., July 28, 1892.
600. *Pogonatum alpinum* var. *microdontium* Kindb. On rocks, St. George Island, Bering Sea, *J. M. Macoun*, July 15, 1892.
601. *Sphagnum medium* var. *pallescens* Warnst. Otter Pond, P.E.I., June 30, 1888.
602. *Sphagnum cuspidatum* var. *submersum* Schimp. Otter Pond, P.E.I., June 30, 1888.
603. *Sphagnum russowii* Warnst. In bogs at Blaketon and Green Harbor, Newfoundland, *Rev. Charles Waghorne*, July 1891.
604. *Desmatodon cernuus* var. *xanthopus* Kindb. On black earth, Boggy Creek Crossing, Man., Aug. 12, 1872.
605. *Barbula nitidum* [sic] (Lindb.) Jur. On wet earth at Hector, Rocky Mountains, B.C., Aug. 14, 1890.
606. *Barbula megalocarpa* Kindb. var. On rocks, Deer Park, Arrow Lake, B.C., June 12, 1890.
607. *Grimmia chloroblasta* Kindb. On dry rocks, alt. 3500 ft., mountain at Spence's Bridge, B.C., May 28, 1890.
608. *Grimmia arcuatifolia* Kindb. On dry rocks, Mount Tolmie, near Victoria, Vancouver Island, April 21, 1887.
609. *Grimmia atricha* Muell. & Kindb. On broken rocks, alt. 4000 ft., Sproat Mountain, Columbia River, B.C., June 24, 1890.
610. *Barbula subulata* Beauv. On earth by the sea, Victoria, Vancouver Island, May 15, 1893.
611. *Sphagnum squarrosum* Pers. In peat bogs, Hastings Co., Ont., Oct. 10, 1893.
612. *Cynodontium strumiferum* (Ehrh.) DeNot. On damp rocks, Burnside Road, Victoria, Vancouver Island, May 11, 1893.

613. *Barbula circinatula* Muell. & Kindb. On damp rocks and by roadsides, Burnside Road, Victoria, Vancouver Island, May 1893.
614. *Racomitrium micropus* Kindb. On rocks, Selkirk and Gold Range Mountains, B.C., Aug. 1889.
615. *Hedwigia ciliata* var. *subnuda* Kindb. On boulders in woods, Brighton, Ont., Oct. 16, 1893.
616. *Orthotrichum cylindrocarpum* Lesq. On rocks, "Dry Canyon," Devil's Lake, Rocky Mountains, Aug. 10, 1893.
617. *Grimmia depilata* Kindb. On rocks, Parson's Mountain near Victoria, Vancouver Island, May 17, 1893.
618. *Fissidens incurvus* Schwaegr. On earth of turned-up stumps, Comox and Victoria, Vancouver Island, June 1893.
619. *Fissidens incurvus* var. *viridus* [sic] Kindb. On a bank along an old road, Comox, Vancouver Island, June 30, 1893.
620. *Racomitrium protensum* Braun. On rocks, Colquitz River, Burnside Road, Victoria, Vancouver Island, May 22, 1893.
621. *Racomitrium canescens* var. *lutescens* Lesq. & James. On damp rocks by roadside, Goldstream, Vancouver Island, June 2, 1893.
622. *Webera macounii* Kindb. In a wet railway cutting, Goldstream, Vancouver Island, June 2, 1893.
623. *Mielichhoferia trichophora* Kindb. On rocks exposed to the sea, Cadboro Bay, Vancouver Island, May 31, 1893.
624. *Ulota maritima* Muell. & Kindb. On rocks exposed to the sea, Cadboro Bay, Vancouver Island, May 31, 1893.
625. *Pterogonium brachypterum* Mitt. On old logs, Sturgeon Creek, Leamington, Essex Co., Ont., Sept. 1890.
626. *Pylaisia filari-acuminata* Muell. & Kindb. On old logs subject to inundation, Revelstoke, B.C., May 3, 1890.
627. *Pseudoleskea radicosa* Mitt. On rocks, Roger's Pass, Selkirk Mountains, Aug. 7, 1890.
628. *Bryum capillare* var. *falcicuspis* Kindb. On damp rocks, near Victoria, Vancouver Island, May 8, 1893.
629. *Bartramia glauco-viridis* Muell. & Kindb. Crevices of damp rocks, near Victoria, Vancouver Island, *J. Macoun*, May 11, 1893.
630. *Bryum capillare* var. *erythroloma* Kindb. On wet rocks in ravine, Goldstream, Vancouver Island, June 2, 1893.
631. *Bryum simplex* Kindb. Near the summit of Mount Benson, Nanaimo, Vancouver Island, July 10, 1893.
632. *Barbula spadicea* Mitt. On the border of a ditch, Comox, Vancouver Island, June 20, 1893.
633. *Barbula vinealis* Braun. On wet gravelly earth, Comox, Vancouver Island, June 19, 1893.
634. *Trichostomum anomalum* Schimp. On cultivated ground, Sea's Farm, near Victoria, Vancouver Island, May 18, 1893.
635. *Racomitrium speciosum* C. M. On exposed rocks, Parson's Mountain, Vancouver Island, May 19, 1893.
636. *Webera polymorphoides* Kindb. Close to the glacier, alt. 7500 ft., Hermit Mountain, Selkirk Mountains, B.C., 1880.
637. *Webera micro-apiculata* Muell. & Kindb. Wet rocks by the torrent, Hector, Rocky Mountains, B.C., Aug. 13, 1890.
638. *Bryum erubescens* Kindb. Near the discharge of Lake Louise, Laggan, Rocky Mountains, Alta., Aug. 18, 1891.
639. *Bryum angustirete* Kindb. Wet rocks at the Kananaskis, Rocky Mountains, Alta., June 23, 1885.
640. *Bryum intermedium* var. *mamilligerum* Kindb. On damp rocks and earth, Devil's Lake, Rocky Mountains, Alta., July 17, 1891.
641. *Bryum bimum* var. *angustifolium* Kindb. On wet rocks, Cape Vincent, Kingston, Ont., *Prof. J. Fowler*, 1881.

642. *Zieria julacea* Schimp. On rocks along the Bow River, Morley, Rocky Mountains, Alta., July 27, 1885.
643. *Mnium rugicum* Laur. Dow's Swamp, near the pond, Ottawa, Ont., Oct. 14, 1889.
644. *Mnium cinclidioides* Hueb. In wet, boggy woods, Nanaimo, Vancouver Island, June 3, 1887.
645. *Thuidium whippleanum* Sull. On damp rocks, Victoria Arm, Victoria, Vancouver Island, May 13, 1893.
646. *Camptothecium arenarium* Lesq. On the sand spit, Comox, Vancouver Island, July 3, 1893.
647. *Camptothecium aeneum* Mitt. Abundant on rocks in a ravine, Goldstream, Vancouver Island, June 2, 1893.
648. *Heterocladium vancouveriense* Kindb. On rocks in a ravine, Goldstream, Vancouver Island, June 2, 1893.
649. *Camptothecium amesiae* Ren. & Card. On oak trees, Burnside Road, Victoria, Vancouver Island, May 16, 1893.
650. *Brachythecium subintricatum* Kindb. On rocks along a brook, Meeche's Lake, Que., Sept. 24, 1893.
651. *Brachythecium spurio-rutabulum* Muell. & Kindb. On the bases of trees, Burrard Inlet and Vancouver Island, B.C.
652. *Grimmia canadensis* Kindb. On rocks, Parson's Mountain, Victoria, Vancouver Island, May 13, 1893.
653. *Brachythecium intricatum* (Hedw.) Kindb. On stones in woods, Meeche's Lake, Que., Sept. 23, 1893.
654. *Hypnum pseudofiliforme* Kindb. On earth and rocks, Colquitz River, Victoria, B.C., May 18, 1893.
655. *Hypnum sequoieti* Muell. On old stumps and trees, Victoria, Vancouver Island, May 31, 1873.
656. *Isothecium pleurozioides* Kindb. On rocks in a ravine, Goldstream, Vancouver Island, June 2, 1893.
657. *Hypnum uncinatum* var. *symmetricum* Kindb. On old log over Colquitz River, Victoria, Vancouver Island, May 22, 1893.
658. *Hypnum pseudo-stramineum* Kindb. On wet earth in fields, Sea's Farm, Victoria, Vancouver Island, May 22, 1893.
659. *Rhynchostegium rusciforme* var. *inundatum* Kindb. On rocks in a brook, Meeche's Lake, Que., Sept. 23, 1893.
660. *Heterocladium dimorphum* Brid. On rocks, Canaan Forks, Queen's Co., N.B., *J. Moser.*
661. *Oligotrichum latifolium* Kindb. *O. hercynicum* var. *latifolium* Muell. & Kindb. [The latter name in much larger letters though apparently intended as a synonym.] By a glacier stream, Roger's Pass, Selkirk Mountains, B.C.
662. *Sphagnum medium* var. *roseum* Warnst. In peat bog, Eastman's Springs, Ont., Oct. 11, 1892.
663. *Entodon seductrix* (Hedw.) Muell. On earth and logs in woods, Niagara-on-the-Lake, June 26, 1892.
664. *Orthotrichum schimperi* Hamm. On locust trees, Sandwich, Essex Co., Ont., May 24, 1892.
665. *Pseudoleskea atrovirens* Dicks. var. On rocks, Roger's Pass, Selkirk Mountains, B.C., Aug. 2, 1890.
666. *Orthotrichum kingianum* Lesq. On rocks, near Hector, Rocky Mountains, B.C., Aug. 13, 1890.
667. *Pogonatum contortum* Lesq. On the roots of upturned trees, Revelstoke, B.C., May 12, 1890.
668. *Dicranoweisia obliqua* Kindb. On rocks by Asulcan Creek, Selkirk Mountains, B.C., Aug. 8, 1890.
669. *Meesia longiseta* Hedw. In swamp, Seymour West, Northumberland Co., Ont., Oct. 1893.
670. *Pseudoleskea oligoclada* Kindb. On rocks, Mount Benson, Nanaimo, Vancouver Island, July 10, 1893.

A NEW *RAMALINA* WITH TWO NEW DEPSIDES*

WILLIAM LOUIS CULBERSON AND CHICITA F. CULBERSON**

SUMMARY

The new lichen species *Ramalina sayreana* (Ascomycetes: Ramalinaceae) from central Mexico produces a homologous series of orcinol *para*-depsides including 2–*O*–methylstenosporic acid (the major product) and 2–*O*–methyldivaricatic acid, both of which are new substances, and 2–*O*–methylperlatolic acid.

A chemically distinctive species of the *Ramalina americana* group was recently collected in the highlands of central Mexico. Its secondary products include two new depsides, a class of compounds characteristic of the lichen-forming Ascomycetes. This species is named in honor of the American botanist Geneva Sayre.

Ramalina sayreana W. Culb. & C. Culb., sp. nov. (Ramalinaceae)

A *Ramalina americana* et specieribus affinibus materia chemica medullae differt; acidos 2–*O*–methylperlatolicum, 2–*O*–methylstenosporicum, et 2–*O*–methyldivaricatum continens.

Thallus pale-yellow, erect and tufted, to 4.5 cm high, moderately branched throughout but more so toward the tips; branches 1–2–(3) mm broad, reaching 5 mm in the oldest parts, with punctiform or striate pseudocyphellae on the surfaces and (more commonly) the thallus margins. Cortex irregular, 25–65 μm thick; medulla (50)–65–100–(130) μm thick. Apothecia abundant, lateral to subterminal, to 1–2 mm broad, flesh-colored like the thallus, the margins with a few V-shaped indentations; hymenium 50–80 μm thick, subhymenium 40–60–(80) μm; spores 8, ellipsoid, mostly straight, 2-celled, (4)–5–8 × 13–16 μm. Pycnidia not present. Medulla K–, C–, KC–, PD–.

Chemical constituents: Usnic acid, 2–*O*–methylperlatolic acid, 2–*O*–methylstenosporic acid (major product), 2–*O*–methyldivaricatic acid, and trace compounds by TLC.

Mexico. México: Ca. 26 km S of Toluca. Ca. 3100 m elev. On the trunk of *Abies* sp., growing with an abundance of *Ramalina asahinae*. *W. L. Culberson 18192 and C. F. Culberson* (DUKE, holotypus).

Ramalina sayreana forms a chemically distinctive segment of the *R. americana* complex. *Ramalina americana* Hale, a widespread species in the eastern half of the United States and adjacent Canada, was previously considered to be *R. fastigiata* (Pers.) Ach. (Hale, 1978). The latter species is now known to be exclusively European. In its main range *R. americana* produces only usnic acid (Race 1). In the Southern Appalachians, how-

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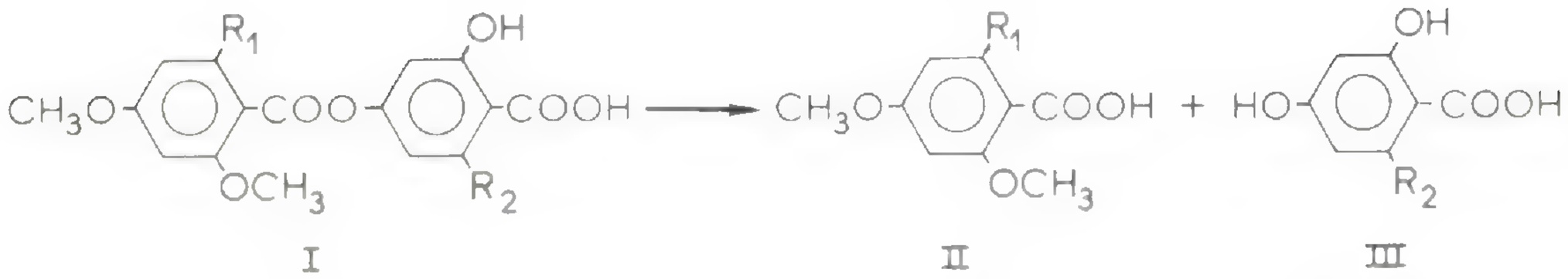


FIGURE 1. Chemical structures of 2–*O*–methylperlatolic acid (I; R_1=R_2=C_5H_{11}), 2–*O*–methylstenosporic acid (I; R_1=C_3H_7, R_2=C_5H_{11}), 2–*O*–methyldivaricatic acid (I; R_1=R_2=C_3H_7), 2,4–di–*O*–methylolivetolcarboxylic acid (II; R_1=C_5H_{11}), 2,4–di–*O*–methyldivaric acid (II; R_1=C_3H_7), olivetolcarboxylic acid (III; R_2=C_5H_{11}), and divaric acid (III; R_2=C_3H_7).

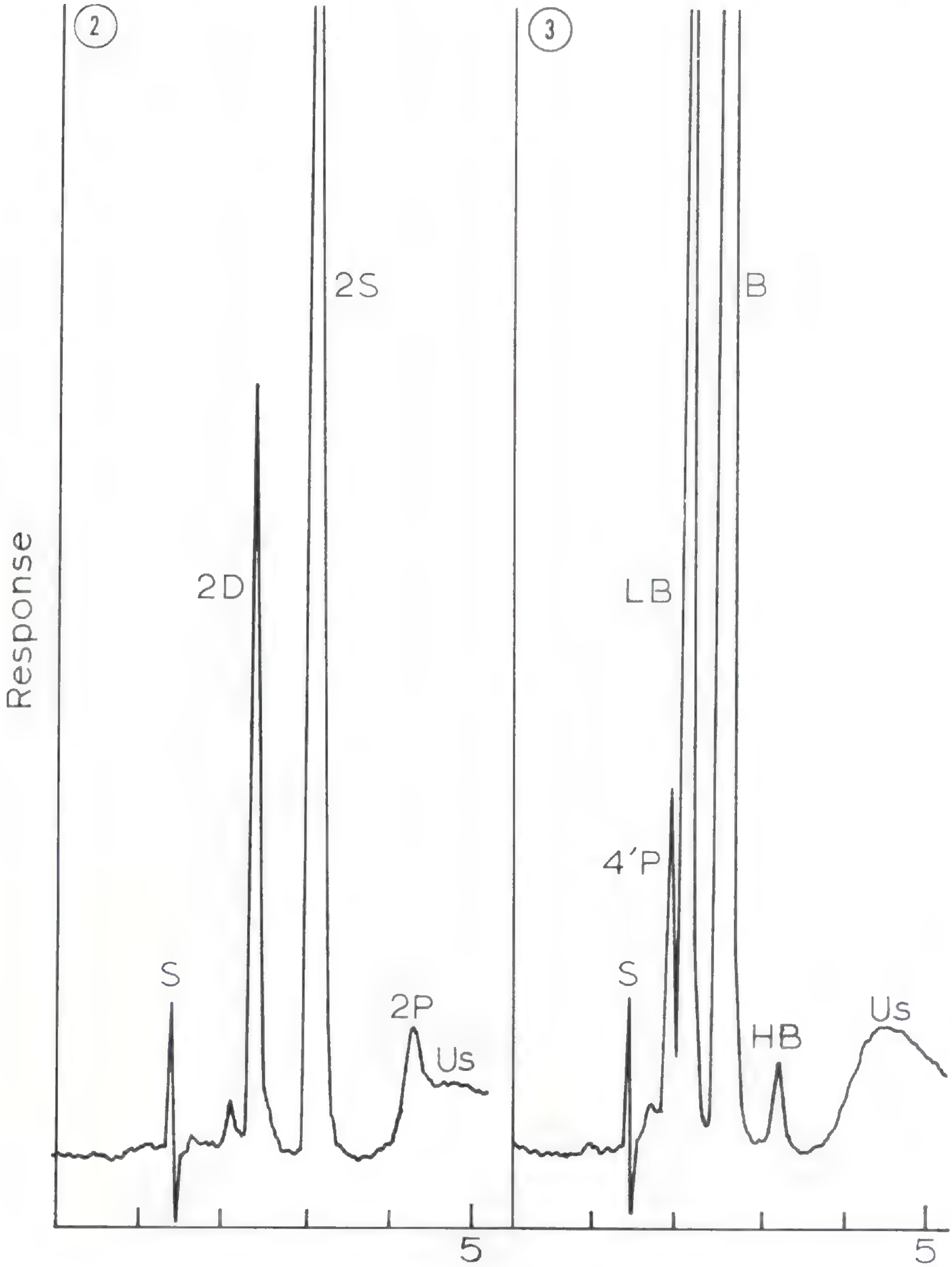
ever, there are four additional chemotypes referred to *R. fastigiata* by Dey (1978) and tentatively included in *R. americana* by Hale (1978). In studying the natural products of *R. sayreana*, we re-examined Dey's materials by thin-layer chromatography (TLC method: C. F. Culberson & Ammann, 1979) to establish that the unidentified compounds reported by him did not include the two new depsides found here. His "*Parmelia quintaria* unknowns 1 and 2" (Race 2) are hypostictic and hyposalazinic acids respectively (*Dey 1114A*, *1357A*, and *4735*, DUKE). The unidentified substance (Race 4) just below barbatic acid in all solvents of the standardized technique is divaricatic acid mixed with another compound of nearly identical Rf (*Dey 1349* and *2294*, DUKE). The four unidentified substances (Race 5) include a high proportion of 4–*O*–demethylbarbatic acid but no traces of our new compounds (*Dey 6260*, DUKE). No material was available of the Race 3, reported to contain sekikaic and homosekikaic acids, but an examination of the original chromatograms showed Dey's identification to be correct.

Thin-layer chromatography of acetone extracts of *Ramalina sayreana* showed usnic acid and three prominent spots, closely spaced and with high Rf values in solvents B and C, characteristic of a homologous series of orcinol depsides. The small spot with highest Rf values exactly matched 2–*O*–methylperlatolic acid. The large spot of intermediate Rf and the small one of low Rf were expected to be the 2–*O*–methyl derivatives of

TABLE 1. STANDARDIZED TLC DATA IN SOLVENTS A, B, AND C

Acid	Rf Classes	Rf × 100 A	B	C
2–*O*–Methylperlatolic	5,6,6	~49/45,87*	60/34,76	68/31,89
2–*O*–Methylstenosporic	5,5–6,6	49/45,87	56/34,76	65/31,89
2–*O*–Methyldivaricatic	4,5,5–6	46/45,87	52/34,76	60/31,89
Olivetolcarboxylic	4–5,6,5	47/45,87	59/34,76	39/31,89
Divaric	4,5–6,5	45/45,87	54/34,76	34/31,89
2,4–Di–*O*–methylolivetolcarboxylic	5,5,6	53/45,87	47/34,76	66/31,89
2,4–Di–*O*–methyldivaric	5,5,5–6	50/45,87	43/34,76	61/31,89

* Masked by 2–*O*–methylstenosporic acid.



FIGURES 2, 3. HPLC analyses (at 2.0 ml/min) of residues from acetone extracts redissolved in methanol. The compounds are methanol solvent (S; 1.45 min), 2-*O*-methylperlatolic acid (2P; 4.25), 2-*O*-methylstenosporic acid (2S; 3.10), 2-*O*-methyldivaricatic acid (2D; 2.42), 4,4′-di-*O*-methylcryptochlorophaeic acid (HB; 3.33), boninic acid (B; 2.62), 2-*O*-methylsekikaic acid (LB; 2.17), 4′-*O*-methylpaludosic acid (4′P; 1.97), and usnic acid (Us; broad peak centered near 4.7 min).—2. *Ramalina sayreana*.—3. *R. asahinae*.

known homologues of perlatolic acid with side chains totalling eight and six carbons respectively. The most probable structure for the major product, with intermediate Rf value, would be either 2–*O*–methylstenosporic acid or 2–*O*–methylimbricaric acid; the most probable structure of the lowest spot would be 2–*O*–methyldivaricatic acid (Fig. 1). Hydrolysis (H_2SO_4) of the crude extract gave large spots of olivetolcarboxylic and 2,4–di–*O*–methyldivaric acids and small ones of divaric and 2,4–di–*O*–methylolivetolcarboxylic acids (Fig. 1). This finding would be predicted both qualitatively and quantitatively for the hydrolysis of 2–*O*–methylstenosporic acid mixed with smaller amounts of the higher and lower homologues, 2–*O*–methylperlatolic and 2–*O*–methyldivaricatic acids. Table 1 gives standardized Rf data for the three depsides and their four hydrolysis products.

The holotype and only known specimen of *Ramalina sayreana* grew among a rich development of *R. asahinae* W. Culb. & C. Culb., a sorediate species of the *R. farinacea* group recently described from Chiapas (W. L. Culberson & Culberson, 1976). Figure 2 compares residues from acetone extracts of these species by high performance liquid chromatography. Aliquots in methanol were chromatographed on a Zorbax ODS (25.0 cm × 4.6 mm) column with a mobile phase of methanol/water/acetic acid (58:9:1). The homologous series of *meta*-depsides including boninic acid and the homologous series of *para*-depsides including 2–*O*–methylstenosporic acid are clearly discernible.

A two-dimensional C × B chromatogram (method: C. F. Culberson & Johnson, 1976) of an acetone extract of a fragment of the holotype of *Ramalina asahinae* (*Culberson 16538*, DUKE) showed two series of homologous *meta*-depsides, one being boninic acid with its higher and lower homologue and the other being the 4–*O*–demethyl derivatives. This result agrees with the earlier report by Chester and Elix (1978), however, we also find 4′–*O*–methylcryptochlorophaeic acid and a moderate proportion of another substance not identical to ramalinolic acid as previously suspected (W. L. Culberson & Culberson, 1978).

The present report of the new *meta*-depside 4′–*O*–methylcryptochlorophaeic acid in *R. asahinae* is based upon chromatographic properties and biogenetic considerations and should be confirmed when additional material is available. The material of *R. asahinae (Culberson 17103)* growing with *R. sayreana* will be distributed in Vězda's *Lichenes Selecti Exsiccati*.

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THE ORIGIN OF DIATOM BIOLOGY IN AMERICA

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SUMMARY

Diatom biology originated in America around 1840 in the publications of Jacob W. Bailey. This sketch examines the influences of John Torrey, the American scientific community, especially its geologists, and the contemporary states of microscopy and diatom biology on the composition and direction of Bailey's early work.

In August of 1856 at its annual meeting in Albany, New York, the American Association for the Advancement of Science elected as its president Jacob Whitman Bailey, the Professor of Chemistry, Mineralogy and Geology at the United States Military Academy at West Point. As the Association's ninth president Bailey was to assume a most prestigious chair, one previously occupied by such leading American scientists as Joseph Henry, Alexander Bache, Louis Agassiz, James Dana and John Torrey. But during February of 1857 Bailey died as a result of frailties and illnesses that had plagued him for nearly a decade. Augustus A. Gould eulogized the President-elect at the Montreal meeting that August and reiterated that the reason Bailey had been chosen to preside over the Association was for his "advancement of Science, American Science and American Scientific character" (Gould 1858). The Association recognized not only Bailey's contributions to the microscopical aspects of biology and geology but also his participation in the maturation of the American scientific community. An examination of the origin and early development of diatom biology in America necessarily focuses on Bailey. His contributions were both critical and forceful. Such an examination also requires consideration of the influence of the scientific community of which he became a part.

In the eighteenth century the experts and the publications on the American flora were European. The original collections of American plants largely resided in European herbaria. The story of nineteenth century American botany describes the development of independent botanical resources—specialists, herbaria, gardens and centers of research and education. Similar transitions occurred in the other natural sciences, in particular, zoology and geology. By the 1830's America had developed a functional scientific community of her own led by a group of men who were primarily American educated (almost half medically), specialized in their contributions, and largely employed as professors of the sciences (Daniels 1968). Bailey was a member of this group, but he differed in being primarily self-educated and militarily educated. After the age of 12 his only formal education was as a cadet at the U. S. Military

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Academy from 1828 to 1832. Even though he had maintained and developed his interests in mineralogy, botany and microscopy from his boyhood days in Providence, Rhode Island, his course after graduation from the Academy was as an officer in the artillery corps, in which he served tours of duty in Virginia and South Carolina between 1832 and 1834. Bailey's correspondence through 1834 alludes occasionally to his botanical interests but suggests no contemplation of a career in science.

The curriculum at the Academy shortly after it was founded in 1802 was commensurate with that of secondary schools, but gradually through the 1820's and early 1830's Superintendent Sylvanus Thayer transformed it into a college. It emphasized training in mathematics and natural philosophy (physics) to a degree unconventional in early nineteenth century American higher education and in military engineering modelled after that of the École Polytechnique in Paris (Lovell 1979). In 1820, as part of his revitalization of the Academy's program, Thayer initiated instruction in chemistry, mineralogy and geology, but because Congress had authorized no professorship for these disciplines, he was constrained to appoint only an Acting Professor and assistants drawn from within the ranks of the Army, generally adjuncts to the Surgeon's Office. In this capacity, John Torrey, M. D., taught these subjects at the Academy from 1824 to 1828. In 1829 one of Torrey's ablest students, William W. Mather, an 1828 graduate of the Academy, assumed the instruction in these sciences. Among his students was J. W. Bailey. Personnel turnover within this unofficial department in 1834 necessitated again drafting instructors from the ranks. Actually, Thayer preferred his instructors to be Academy graduates, because he felt his "seminary-academy" system would be maintained best by those who had already experienced it (Lovell 1979). As a result, in 1834 Bailey was reassigned from his position as Post Commander of the Bellona Arsenal near Richmond, Virginia to West Point. In February of 1834 he wrote to his mother of his reassignment: "The uncertainty of all things in the army is so great that I cannot feel *quite* certain that something or other may prevent my obeying this very agre[e]able order . . . I do not know what duties [there] will be for me to perform at West Point. If I am to be Assistant Professor of any subject which I feel I can teach, I shall like the situation much" (Bailey 1834). Bailey's task was instruction in chemistry, mineralogy and geology, and through the first year he worked with Mather, who, in June of 1835, left the Academy to assume the position as geologist for the First District of the New York State Geological Survey. In 1838 Congress finally authorized the appointment of a Professor of Chemistry, Mineralogy and Geology, and it was awarded to Bailey, who held it for the next two decades.

Bailey's movement into the American scientific community was facilitated by his assignment to an academic position at the Academy, but it

was activated and sustained by his involvement with John Torrey. His years at West Point had not coincided with Torrey's, yet he knew of Torrey through his interest in botany and through Mather. His first meeting with Torrey occurred in May of 1835 and was joyously recorded in his diary: "Be the day ever remembered! for on it I first became acquainted with a scientific botanist, and he too the first botanist in America, in short no less a person than the distinguished Dr. John Torrey of New York. I was introduced to him at the hotel [at West Point] by Lieut. Mather. I was much surprised to find him so young a man [Torrey was 38]. After conversing a while, he proposed a botanical excursion and we proceeded down the hill behind the hotel collecting *Corydalis*. . . ." (Bailey 1835). So began one of many "botanical excursions" by the two and a strong personal and professional friendship. Both shared making a living by teaching chemistry, at least, but for each their love of botany was a higher calling. Bailey wrote to Torrey that "I. . .cannot be a zealous mineralogist in summer, any more than you, say, you can be a chemist, for there is something so much more fascinating in Botany than in any other science, that in summer, it is sure to cause [a] feeling of indifference, if not disgust for all other pursuits" (Bailey 1837). Torrey functioned as Bailey's botanical mentor. Through 1838 he sketched plants for Torrey, examined plants microscopically for him and did other odds and ends: "Whatever I can do to promote the advancement of a science to which I have been indebted for so many happy hours will of course gratify me" (Bailey 1836). His initial publications (1837–1838), all in *Silliman's Journal (American Journal of Science and Arts)*, show simultaneously his breadth and diffusiveness: on galvanic experiments in frogs, on practical chemical procedures, on a botanical excursion to Maine, on assaying nitric acid, on a peculiar mineral, on the use of the blowpipe in chemistry, on the vascular system of ferns, and on an abnormal flower in *Orchis* (Edgar 1977). By 1838 he had not established a scientific focus.

In September of 1837 Charles Daubeny, the Oxford chemist and botanist, visited Torrey in New York and presented him with a sample of a German diatomaceous earth that he had received from Christian G. Ehrenberg. Recognizing Bailey's skill and interest in microscopy, Torrey sent the sample to West Point as a potentially interesting specimen. In June of 1838 Bailey wrote to Torrey about what he had discovered in the sample and suggested that "I might contribute a small mite to the advance of botany, if I could determine and figure the various species of the tribe Diatomae which appear to be very abundant about West Point" (Bailey 1838a). His contribution appeared four months later in *Silliman's Journal* as a paper entitled "On fossil infusoria, discovered in peat-earth, at West Point, N. Y., with some notices of American species of Diatomae" (Bailey 1838b). His second paper on this subject would not appear until three years later in Edward Hitchcock's *Final Report on the Geology of Massa-*

chusetts (Bailey 1841a). In that period he published on no other subjects and in response to the encouragement of Torrey and American geologists solely pursued the diatoms and other microalgae. His work during this period would culminate in his serial "Sketch of the infusoria, of the family Bacillaria, with some account of the most interesting species which have been found in a recent or fossil state in the United States" (Bailey 1841b, 1842a, b).

Around 1840 natural science, American science and diatom biology were exceptionally dynamic. The American scientific community labored to produce a science commensurate in quality and breadth with that of its European counterparts. Geologists struggled with the case for uniformitarianism that Charles Lyell had presented barely a decade earlier. Microscopical science witnessed quantum advances in the availability of improved optics. Biologists studying diatoms debated the animal versus vegetable nature of their subjects while involved in a major transition in their classification. Diatom biology arose in America at this time in this context—a context strikingly reflected in Bailey's first two publications about diatoms (1838b, 1841a), especially in the plates of illustrations contained in them (Figures 1 and 2).

The most apparent feature of these two plates is that they depict primarily fossil diatoms. This uniquely illustrates the micropaleontological context in which diatom biology arose in America and the momentum provided by geologists for a sustained investigation of the group. With the exceptions of the publications of Ehrenberg, these two plates are among the earliest illustrations of fossil diatoms.

Diatom micropaleontology originated soon after the discovery of the highly refractive, siliceous nature of the diatom frustule. In 1833 Friedrich Kützing intimated the siliceous character of the wall by referring to it as "glassy," although he did not confirm his suspicions by chemical analysis until the middle of 1834 (Kützing 1844). The paper on his discovery which he submitted to *Annalen de Physik und Chemie* (Leipzig) was never published, but instead, under the auspices of the Royal Prussian Academy, Ehrenberg (1834) published a notice confirming Kützing's discovery. Knowledge of the discovery led Christian Fischer to reveal the diatomaceous nature of tripoli, which Ehrenberg (1836) also reported as the first in a long series of papers on fossil diatoms and infusoria. In 1836 Alphonse de Brébisson reported the results of his own analyses of diatomaceous frustules and again confirmed Kützing's observations. Pierre Turpin (1836) made the geological connection by describing Brébisson's analyses as producing "*une sorte de tripoli artificiel.*" Bailey's discovery of the silicification of the frustule was made in ignorance of these reports, and thus independently, although he was aware that diatoms left fossil deposits because of the Ehrenberg sample he received from Torrey. His almost immediate deduction of the high likeli-

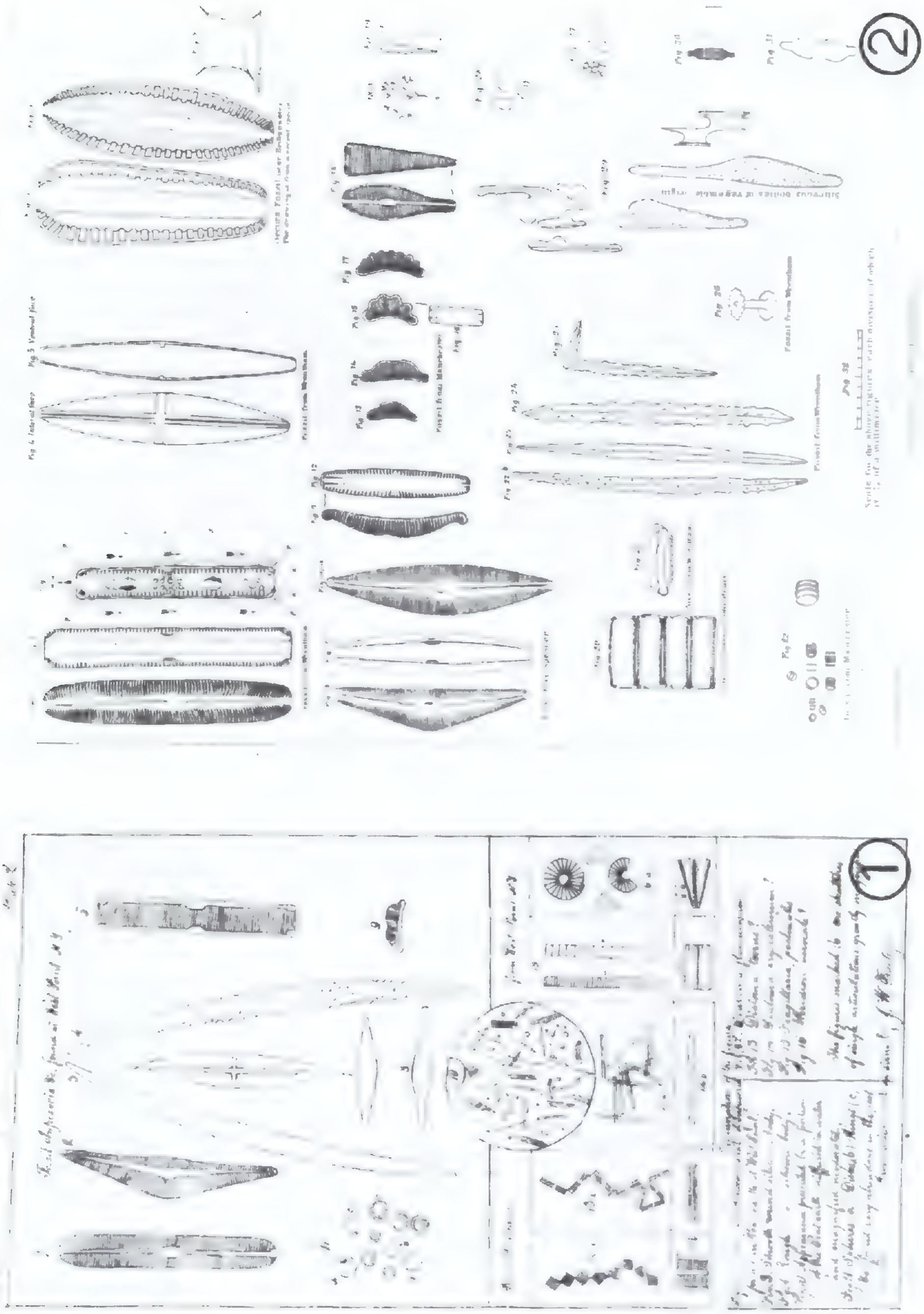

FIGURE 1. From Bailey, 1838 b, pl. 2. FIGURE 2. From Bailey, 1841 a, pl. 20. (Courtesy of the Museum of Comparative Zoology of Harvard University)

hood of fossil deposits *now being formed*, given knowledge of the siliceous frustule, is clear in his 1838 paper and in his correspondence with Torrey. "The imperishable nature of the Bacillariae and Diatomae, led me to suppose that large numbers must be buried in the mud at the bottoms of the bogs, streams, &c., where the living specimens occur, ..." (Bailey 1838b). And to Torrey: "I am happy to inform you that the specimen of fossil infusoria which you kindly gave me, has led me to the discovery of a large deposit of *similar* siliceous shells in a fossil state in the peat bog (or swampy meadow) just south of Fort Putnam. It was here that I first procured the Confervas among whose ashes I found these creatures. From their great abundance in the living state, I felt confident that their shells must exist in great quantities in the earthy matter below, but I was hardly prepared to find the lower stratum of the bog principally composed of a white or grey clay like substance every *speck* of which contains numerous shells of these strange beings. I can send you enough to supply the world if necessary" (Bailey 1838a).

Bailey's unfamiliarity with the foreign literature on diatoms must be attributable in part to his having recently entered the field, but also, it resulted from his difficulty in gathering communications from abroad, a common problem among American scientists of the day. In November of 1836 Bailey wrote to Torrey from West Point: "Will you believe it—the only Scientific Journals now received at the Library of the *United States* Military Academy are *Silliman's Journal* and *Journal of the Franklin Institute*. I have not seen a number of *Annales de Chimie et de Physique* [Paris] since November 1834! 'L'Institute' [*Annales des Sciences Naturelles*] and *Reports of the British Association* [*for the Advancement of Science*] I hear of in the newspapers but that is all" (Bailey 1836). His nearest access to the foreign literature was in New York, either from Torrey or the library at the Lyceum of Natural History. His production of up-to-date science was limited in part by his access to up-to-date resources. And independent discovery was a frequent occurrence. *Silliman's Journal* attempted to partially compensate for this limitation in the American scientific community by publishing extracts from the foreign literature, but all Bailey could have found in it about diatoms before his initial publication was a brief, miscellaneous note that Turpin has connected siliceous opal deposits with the organic remains of *Gallionella* or *Conferva* (Turpin 1837). I have found no indications that Bailey saw this editorial notice.

The fact that the 1841 paper is devoted almost exclusively to fossil diatoms, whereas the first is not, indicates that impetus for continuing American diatom studies was provided by the geologists. Edward Hitchcock reported in his geological survey of Massachusetts in 1838 what he termed "siliceous marls" occurring extensively within the state and that similar deposits had been found by Charles T. Jackson in his geological

survey of Maine. Both agreed that the deposits were basically a hydrate of silica with traces of iron, alumina and magnesia. Upon seeing Bailey's report of the fossil diatoms of West Point, Hitchcock confirmed microscopically that his siliceous marls were also diatomaceous marls. He requested in 1840 that Bailey prepare for his *Final Report* a paper on the diatoms. Hitchcock saw clearly the implications of the discovery: "We have long been accustomed to admire the process by which the minute Polyparia rear the extensive structures known by the name of Coral Reefs, stretching over hundreds of leagues of tropical seas. But now we find that within our own observation, we may see effects no less marvelous, produced by animals [diatoms] of a still more diminutive size—too small, indeed, to be discovered by the naked eye" (Hitchcock 1841a). In his address to the Association of American Geologists and Naturalists in Philadelphia in April of 1841, Hitchcock would paraphrase Linnaeus in characterizing the discovery: "If such is the beginning, what . . . will be the end of this *infinitesimal geology*! We seem fast advancing towards a realization of the proverb, *omnis calx e vermibus, omnis silex e vermibus, omne ferrum e vermibus*" (Hitchcock 1841b). The implication of the discovery had been clear to others also. William Whewell (1839) in bestowing the Wollaston Medal of the Geological Society of London on Ehrenberg in 1839 characterized the report of fossil infusorial deposits as "it has assumed the character of one of the most important geological truths which have been brought to light in our time: for the connection of the present state of the earth with its condition at a former period in its history, ..." And Charles Lyell (1852) would reflect on ideas he had expressed about the diatom deposits over the last decade that, "It is clear that much time must have been required for the accumulation of strata to which countless generations of Diatomaceae have contributed their remains; . . . . for here we discover proofs that the . . . siliceous dust of which hills are composed has not only been once alive, but almost every particle, albeit invisible to the naked eye, still retains the organic structure which, at periods of time incalculably remote, was impressed upon it by the powers of life." Previously, geologists had sought to explain large changes in the earth's surface by large, historical and largely unknowable forces, such as Noachian deluges and volcanoes, but Lyell had made a case for large changes resulting from still extant, small scale forces acting with more or less uniform intensity over long periods of time. The activity of the coral polyp and the resulting coral reef, as alluded to by Hitchcock (although he was only partially a Lyellist), had been a prime example of this. By 1840, in addition, diatoms emphasized even more dramatically the difference in scale. A comparison of the size of diatoms and the size of their fossilized deposits and the demonstration that these deposits were currently being formed provided evidence for uniformitarianism. The initial observations on fossil diatoms were immediately relevant to one of

the most contested subjects of the period. The geological implications of diatoms were recognized by American geologists other than Hitchcock. William Mather, still conducting part of the New York State Geological Survey, and William B. Rogers, who had discovered extensive Tertiary diatomaceous deposits in Virginia as a result of that state's geological survey, solicited Bailey's expertise in 1840 and 1841. In August of 1841 Bailey wrote to his mother that, "Microscopic geology seems to have fallen to my lot in this country and it affords me plenty of work" (Bailey 1841c). The interest in diatoms among geologists was indicated by the 1841 paper in Hitchcock's *Report*. A result of this interest was an emphasis on fossil deposits in the American diatom literature during the next decade.

In the 1838 plate the living diatoms are all named and illustrated as colonies, or, at least, as aggregates, whereas the fossil diatoms in that plate are universally unnamed and drawn as single frustules or valves. This dichotomy in illustration reflects the natural state in which living and fossil diatoms characteristically are found, but the lack of names for the fossil forms indicates the overwhelming emphasis of early European diatom systematists on examination and description of living, macroscopic (and consequently colonial) plants. What little of the diatom literature Bailey had available in 1838 showed this emphasis. In many pre-1820 classifications the characteristics of the diatom filament were the basis of the taxonomy, because the filament was considered the individual plant. This resulted in the inclusion of many diatoms in the genus *Conferva* (see VanLandingham 1968, p. 849–851). The frustule (Latin, *frustulum:* a small piece, a bit) was only a part of the plant. The concept of the frustule as the outer part of a unicellular individual developed gradually and did not become generally accepted until a modified version of Matthias Schleiden's cell theory took hold after 1850. The later taxonomic investigations of Agardh (1824), Kützing (1833a), Greville (1833) and Brébisson and Godey (1835) emphasized characteristics associated with the pattern of organization of frustules into filaments and fronds, frustular shape, frustular accessories (such as stipes), and occasionally the color and placement of the endochrome, all still predominantly characteristics of living plants. Characteristics of the frustule assumed a greater role in the descriptions of Kützing (1844), William Smith (1853, 1856) and Ralfs (1861). By 1872, Hamilton L. Smith, in his "Conspectus of the Families and Genera of the Diatomaceae," would minimize the importance of the characteristics of colonies and living plants and emphasize almost exclusively frustular structure and ornamentation. "A long study of living forms has convinced me that these characters . . . (frondose, stipitate, filamentous, tubular, etc.) . . . are fleeting—not to be relied upon" (Smith 1872). More than three decades earlier Bailey had reached virtually the same conclusion based on his examinations of living and fossil material. He wrote to Torrey in April of 1839: "I feel at this time the want of [a]

complete series of Diatomaceae, for I believe this group needs a revision, and that they may be arranged best, from the characters derived from the form of the frustules, and the invariable markings or lines upon them. These characteristics being indelibly impressed upon the silica appear to me more suitable, than those derived from the spots produced by irregularities of the Endochrome" (Bailey 1839). In the early 1850's Bailey guided H. L. Smith in his initial studies of diatoms, and consequently, these conclusions may not be fully independent ones.

The link between advances in microbial systematics and advances in microscopy has been recognized for a long time (Dujardin 1841). Accordingly, the transition to an emphasis on character variation within the frustule has been viewed as a product of the invention of the achromatic microscope (Hendey 1959, Patrick 1959). But the discovery of fossil diatom deposits occurred in the same period. A microscopic examination of these deposits forces an exclusive focus upon the frustule, because the deposits consist of only the siliceous parts from diatoms. Bailey's examination of fossil deposits stimulated the analysis of character variation in the frustules *per se*. This occurred before he had acquired achromatic optics. The achromat that he later secured facilitated this analysis in addition to revealing characteristics present on a scale smaller than preachromatic optics would permit.

The only references Bailey used in his determinations in the 1838 paper were C. A. Agardh's (1824) *Systema Algarum* and Robert K. Greville's (1833) section on the diatoms in Hooker's *English Flora*. This conclusion is based on the names Bailey applied to the living species of diatoms from West Point and my examination of his notebooks and correspondence. His determinations were consequently confined to living plants and were based solely on written, unillustrated descriptions. Not surprisingly then, his determinations in the 1838 paper were often tentative and his pleas to Torrey for help were frequent: "Can you lend me any books containing plates or detailed descriptions of this tribe? . . . or indeed any work which you think likely to assist me in these observations" (Bailey 1838a) and "I feel most the want of some book containing good figures of the obscurer algae" (Bailey 1839). In preparing the 1838 paper he saw none of Ehrenberg's papers. Like many other American scientists of the period, Bailey was hindered in his ability to compete with the European scientific community by the limited access to information. His characteristic deference to the "authority of Ehrenberg" over the next decade was in large part a result of the realistic recognition of his limited resources.

The fidelity and resolution in the illustrations of frustular structure are considerably greater in the 1841 plate than in the earlier one. Improved optics and improved literature resources are probably responsible for this. In preparing the 1838 plate Bailey had used the fixtures of a Raspail microscope fitted with lenses that he had made himself. The 1838 paper

contained directions for making the lenses! In 1839 he acquired an improved, but still chromatically aberrated, Raspail microscope, but he noted in his correspondence, with sketches, frustular structure that he had been previously unable to resolve. In 1840 in the preparation of the Hitchcock paper, he used an achromatic microscope made by Charles Chevalier of Paris and again noted the increased resolution. Such observations support the idea that the microscope was limiting and not the microscopist. Also, between 1838 and September of 1840 (when the Hitchcock paper was completed) he acquired several new publications on diatoms that significantly affected his work and probably his illustrations of the diatoms rendered for the Hitchcock production. Bailey secured from Torrey the 1833 volume of *Linnaea*, and from it he copied into his notebooks the complete contents and illustrations of two important works by Kützing: "Synopsis Diatomearum" (1833a) and "Ueber die Gattungen *Melosira* und *Fragilaria*" (1833b). Additionally, he obtained Ehrenberg's "Die fossilen Infusorien und die lebendige Dammerde" (1837) and "Recherches sur l'Organisation des Infusoires" in Mandl's *Traité pratique du Microscope* (1839a). The Mandl paper was extracted from Ehrenberg's earlier *Die Infusionsthierchen* (1838). These publications and the earlier botanical literature previously cited in his preparation of the 1838 paper constituted his major taxonomic resources on diatoms in the early 1840's. In preparing the 1841 paper he did not see an unabridged, untranslated copy of the important *Die Infusionsthierchen*. He heard of it initially in January of 1839 by a note in the *New York Review*, over one year before notice of it appeared in the American scientific literature. When he finally located a copy several months later, the price of $55 exceeded his financial means. He never obtained a copy.

In both plates the coarser fossil forms are illustrated bearing central and terminal nodules, axial areas and striae. The striae density in the 1838 plate approximates a limit of 6–7 striae per 10 microns. This approximation is based on estimates of the species illustrated (including Ehrenberg's 1839b and 1841 lists) and the drawings themselves. In *Stauroneis (baileyi) phoenicenteron* (1838, f. 6) the striae are typically finer than 12/10 microns and were unresolved. In the 1841 plate they remain unresolved in the *Stauroneis* (1841, f. 4), but the striae in several *Eunotia* (1841, f. 13–17), which should approximate 10 – 11/10 microns, are illustrated. Approximately 10 striae per 10 microns probably was the upper limit of resolution available to Bailey at this time. It represents about a 50% increase in resolution over that of the 1838 plate. Consequently, striae characterize most species drawn in the 1841 plate, while they are confined to coarse forms in the 1838 plate. In addition, the 1841 plate presented practically all species in paired valve and girdle views indicating Bailey's emphasis on the complete structure of the frustule—an approach not taken in 1838. The basic valve-girdle bands-valve structure of the

frustule is clearly indicated in several illustrations, but in the 1838 plate this tripartite organization is only suggested in some drawings. Terminal nodules are indicated in the 1841 plate in *Eunotia* (f. 16, 20) but not in the 1838 plate (f. 15c). The striae (alveoli) of *Navicula (Pinnularia) viridis* (1838 & 1841, f. 1) are drawn as a single line in the 1838 plate, but in 1841 they are drawn as closed, elongated loops, mimicking the illustration (1841, f. 3) borrowed from Ehrenberg (1837). But most noticeable in the 1841 plate are the illustrations of a raphe in *Pinnularia* (f. 1), *Stauroneis* (f. 4) and *Cymbella* (f. 9, 10a) by means of a median double line. An explanation of the line illustrating the raphe is contained in Bailey's (1842a) "Sketch of the infusoria," in which he elaborated on his interpretation of the structure of the frustule of *Navicula (Pinnularia) viridis*. His interpretation markedly contrasted with that of Ehrenberg (1837). He wrote: "The striae seen on these faces may *correspond* to internal cells, but I believe them to be linear openings in the carapace itself, as may easily be seen on the fragments of the fossil specimens. There are three rounded spaces on each ventral [valvar] face, which I think have been mistaken for openings, but which appear to me to be the thicker portions of the carapace. One of these spaces is in the middle, and the other two at the extremities of the striated surfaces, and they are connected by a very delicate, double line (canal)? A similar structure is seen in several other species of *Navicula*, *Cocconema [Cymbella]* and *Gomphonema*." Bailey's use of the word "canal" should not be confused with the much later-evolved idea of a canal raphe. "Canal" implies an elongated hollow region, an area of decreased silica thickness, and the fact that he used a double line to illustrate it indicates he had begun to appreciate the complexity of the existing microstructure. His interpretation of the structure of the frustule is remarkably similar to that presented by Schleiden several years later in the second edition (1845–1846) of his *Grundzüge der wissenschaftlichen Botanik* (Schleiden 1849). Schleiden also characterized the raphe as a "cleft." Bailey's illustrations of *Navicula viridis* in the Hitchcock paper and the 1842 "Sketch" (1842a, f. 16a) are virtually identical. Double lines in illustrations drawn near the locus of the raphe are exceedingly rare before 1841, but where they do occur, such as Ehrenberg, 1837, pl. 1, f. 19 (redrawn in Bailey 1842a, f. 17a), it is not clear that they represent either frustular structure or a cleft. The newly acquired literature resources alone cannot account for Bailey's production of the 1841 plate or his comments on diatom structure. His skill as a microscopist in using his recently acquired achromatic optics remains the most likely explanation for many of the differences between the two plates, especially with respect to the resolution and interpretation of structure.

The observation that all the fossil diatoms in the 1841 plate are named (and none are named in the 1838 plate) indicates Bailey had acquired, by 1840, some of Ehrenberg's literature. But, the other result of this

acquisition was to transform the botanical terminology of the diatoms in the 1838 paper *(algae, articulations, frustule, diatom)* into the zoological terminology of Ehrenberg *(animal, carapace, polygastric, bacillaria)*. This transformation reveals a then current debate about the classification of diatoms and about basically what differentiated plants and animals. Bailey had sketched the two sides of this debate in his 1838 paper by quoting extensively from the review of Meyen (1837), and he summarized the points again in the Hitchcock paper. In the final analysis Bailey interpreted diatoms as animals because of their "voluntary motility," their clear ability to move in response to no apparent exogenous stimulus. Ehrenberg's view of the diatoms stemmed from his ideas about the "chain of being" *(scala naturae)* and the zoological classification of Georges Cuvier (Jahn 1971, Winsor 1976). He included the diatoms among the infusorial animals, which were grouped in Cuvier's embranchement Radiata. He believed diatoms contained organs such as stomachs, a carapace, a mouth, and sexual organs and that they possessed an anatomical organization no simpler than that of any other radiate animal. He maintained also that the Radiata were no simpler in their organization than the other embranchements, which according to Ehrenberg's interpretation of Cuvier contained the Perfect Animals. Ehrenberg's observations on diatoms were intent on demonstrating that they were not in any structural sense organ-deficient and not built upon a body plan simpler or different from that of the Perfect Animals. The full title of his important 1838 work, *Die Infusionsthierchen als vollkommene Organismen*, indicates a treatment of infusorial animals as complete or perfect in this sense. Derivative from this demonstration was an argument against spontaneous generation and against transitions ascending a *scala naturae*. In large part Bailey did not agree with Ehrenberg's interpretation of diatom structure, as he illustrated previously with the structure of *Pinnularia*. He also had no dogmatic mold into which his observations had to fit. Bailey and Ehrenberg agreed diatoms were animals, but their views of them were radically different.

Werner (1972) in some remarks on the history of diatom biology has noted both the terms *diatoms* and *bacillariae* were historically applied to the taxon we now commonly call *diatoms*. He segregates several nineteenth century diatomists with respect to the term they favored, and in this segregation he indicates that Bailey favored *diatoms*. But he cites as a reference for this favoring Bailey's 1842(a) "Sketch of the infusoria, of the family *Bacillaria*, ...," a paper in which neither *diatom* nor a derivative appears. But this should not be construed to mean that Bailey favored *bacillaria*. In the 1838 paper he called this group *diatoms*. In his 1841 Hitchcock paper he called them *bacillariae*. In his 1840's geological papers he referred to them generally as *siliceous bacillariae*. After about 1848, when he fell under the influence of the Irish phycologist William H.

Harvey, he again called them *diatoms*. Bailey used the terminology of the botanists when most closely allied with them and that of the zoologists when engaged primarily in micropaleontology, which was then so strongly influenced by Ehrenberg. Werner also commented that the choice of *diatoms* as the common name for the group by authors including Bailey was "possibly due to the similarity of *bacillae* and *bacteriae* [to *bacillariae*]." This is purely speculative and unsupported by the evidence. It implies either no difference in the meanings of the two words (*diatoms* vs. *bacillariae)* or a relatively unimportant one, so that selection of the name followed the path of least orthographic confusion. In the nineteenth century *diatoms* was not considered equivalent to *bacillariae*. This was perhaps best illustrated by Kützing (1844) who entitled his major work *Die kieselschaligen Bacillarien oder Diatomeen*, qualifying the application of *bacillariae* with the adjective *siliceous-shelled*. The group denoted by *bacillariae* has traditionally been more comprehensive than the one denoted by *diatoms*. *Diatom* was a botanical term referring to the incision-like interruptions in filaments of various colonial diatoms, *viz*., *Diatoma* (Greville 1833). *Bacillariae* referred to the shape of frustules of *Bacillaria paradoxa*, which in early classifications was included with the "staff animals" (Gmelin 1788). *Bacillariae* was most extensively promulgated in the nineteenth century by Ehrenberg and those whose classifications descended from his. It incorporated primarily the diatoms and desmids. Such classifications (Ehrenberg 1838, Pritchard 1852, 1861) consistently used *diatoms*, if at all, to refer to a group less inclusive than that named by *bacillariae*. Consequently, the common name *diatoms* that evolved to specify the group by the end of the nineteenth century resulted from the recognition that diatoms were plants, their union within the algae, under the domain of the botanists, and from the fact that *bacillariae* had consistently denoted a larger set than did the subset *diatoms*. *Diatoms* sufficiently and more parsimoniously circumscribed the elements in question.

A. A. Gould's eulogy took special note of Bailey's contribution to the advancement of the "American Scientific character." Though this can be assumed to refer to the most admirable qualities of a scientist, it probably refers also to Bailey's perserverance despite substantial obstacles. There is also reason to believe "American Scientific character" connotes a fundamental nationalistic competitiveness. A significant component of the motivation behind the Wilkes Exploring Expedition (1838–1842) was jingoistic (Stanton 1975). Bailey would not have objected to pride in American science, as long as it was not a false one (Edgar 1979). He wrote to William B. Rogers soon after the discovery of the extensive Tertiary diatom strata in Virginia and Maryland that "I think we may now challenge the world to produce infusorial deposits equal in extent to those of which you made the truly 'splendid' discovery. In America, in spite of

old Buffon, Nature has done all her work on a scale commensurate with an immense territory" (Bailey 1843). The allusion to Georges Buffon is remarkable in that it had been in the previous century that this French naturalist had questioned the quality of the organisms and the environment of North America as part of his description and explanation of continental biogeographic differences. Egerton (1976) has pointed out that despite the chauvinism associated with Buffon's ideas, the fact that they were perpetuated "must have served the useful function of encouraging Americans to increase their understanding of their own climate [environment] and its influences upon all forms of life in America." In Bailey's case the allusion to Buffon appeared in a context which reflected a competitive pride in the accomplishments of American science. It suggests part of the stimulus to pursue science was *because* of the chauvinism. This competitive pride is indicated even more acutely by the widely used appellation, initiated by Rogers in 1843, which Bailey received from his American scientific colleagues—"*our* Ehrenberg."

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WHO WAS JOHN TORREY'S "PROF." SHELTON LOST ON THE STEAMBOAT *JENNY LIND?**

JOSEPH EWAN**

SUMMARY

"Prof." C—— C—— Shelton, place and date of birth unknown, collected plants for John Torrey in the mountains above Sacramento. Letters and records not located. He was associated with the artist Paul Emert of New York City, but no record of Shelton's association with founders of California Academy of Sciences were found unless perhaps with Albert Kellogg. Shelton, a victim of the *Jenny Lind* steamboat explosion, collected four California species first named by Torrey.

Naming things, said Henry van Dyke, is one of the oldest and simplest of human pastimes. But *who* was the moss or the mint named for? A modest search tells us *Timmia*, according to Dryander, was named for a consul and pharmacist in the German town of Malchin. For some commemorative names we know a good deal about the man: Henry Nicholas Bolander for whom several California mosses have been named, for example. But when the botanist-librarian Clifton F. Smith asked me if I knew anything of a certain "Mr. Shelton, California Botanist in Travelling Costume" and provided me with a likeness which he had discovered as a loose print in a Santa Barbara bookshop, I admitted with surprise and delight that perhaps a mint, *Monardella sheltoni*, memorialized him. In any event, I would begin a search.[1]

Shelton belongs to the Gold Rush, in the company of Nuttall's protégé William Gambel, the New York taxidermist, John Graham Bell, who collected birds for Cassin in Philadelphia, and Audubon's son, John Woodhouse Audubon, who made the overland journey across Northern Mexico to San Diego before hastening to the gold fields. In the seven months after gold was discovered (on January 24th, 1848, on the American River by James W. Marshall who noticed yellow grains in the tailrace), four thousand men had reached the mines. By the end of the year, ten thousand had arrived, and President Polk declared the richness of the strike was enough to pay for the Mexican War one hundred times over. On December 7th, 230 ounces of gold were delivered to Washington in a tea caddy. One year later, the historian Bancroft estimated, 81,000 people had reached California, 42,000 overland.[2] Benjamin Silliman wrote to the British geologist Gideon Mantell, March 31, 1849, "I agree with you as to the pernicious influence which this 'auri sacra fames' may pro-

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MR. SHELTON, THE CALIFORNIA BOTANIST.

duce. . . [But] many excellent men have gone from [New Haven] and from other parts of New England, and they will, I trust, prove a pioneer pilgrim band, . . . will establish good institutions and laws, and remain behind and possess the land."[3] Among the "excellent men" was Dr. John Boardman Trask, 29, who had travelled with the young Audubon, and who was among the seven founders of the California Academy of Natural Sciences in San Francisco.[4] There was Dr. John Davis Babcock Stillman who sent plants to Torrey and who had shipped on the *Pacific*—cost: $300; passage, 194 days—from New York to San Francisco. A third physician, Timothy Langdon Andrews, also sent plants to Torrey. That "Prof. Shelton" should send a mint, a violet, and a "California nutmeg" to Torrey is in the flush of the Gold Rush.

Most of these plant curiosities of the Gold Rush eventually reached John Torrey at New York, Asa Gray at Harvard, or George Engelmann at St. Louis. A few specimens were delivered to Albert Kellogg, another Forty-niner, at the Academy in San Francisco. Some reached Europe, but how many were lost with the cargoes that hurtled down the gorges of the Sierra Nevada with over-burdened burros?

"Prof. C. C. Shelton" according to James Mason Hutchings of Yosemite, who evidently knew him, was in Texas when the Gold Rush began.[5] While Shelton was a resident in Texas, Asiatic cholera swept his town, killing his mother, brother-in-law, and nephew. He left soon after for Mexico where he worked as a gardener on Mexican estates. During his stay there he administered with great success a remedy for the cholera discovered in India, but about which he had learned in Texas. Sometime in 1850, if we follow the imprecise account by Hutchings, he left for Mazatlan and took passage for San Francisco. Evidently he went directly to the diggings, not for gold, but for plants. During the Fall of 1851 a correspondent of *Hutchings' California Magazine*, identified only as "M.D." met Prof. Shelton at the Bear Hotel in Sacramento where the artist Paul Emert was proprietor. Could this "M.D." have been Dr. Albert Kellogg who, we know, was in the gold district above Sacramento at this time? Emert "subsequently became his traveling companion, to sketch the beauties of California horticulture." "M.D." saw Shelton's room completely filled in a "most glorious confusion" with "hundreds, if not thousands of specimens of the different productions of California." In the yard were "barrels, boxes, bags," too large or dirt-filled to be stored in the hotel room. Shelton told "M.D." that he planned an exhibition. "At this time he had not a dime in his pocket to meet his expenses; and although he had been in the location of the diggings, where men were taking out gold at from ten to fifty dollars per day each, he did not look for gold, but would rather gather the beautiful floral specimens around him. . . . He found some few men who entered into his views and afforded him means to continue his investigations. Then he employed an artist to accompany him to

make drawings of the beautiful flowers he met with." During 1851 Shelton opened what "M.D." called a "museum of natural curiosities" in San Francisco mostly of minerals[6] but, Hutchings remarked, "gold, gold, gold was the engrossing thought of the people then," and the museum did not pay expenses. Shelton began arranging for the State Agricultural Fair that would feature the California fruits and vegetables which he believed excelled those of other states and should be grown more widely. "He saw, but in a little way in the future, an immense State, densely populated, depending on Chili, the Sandwich Islands, Mexico, Oregon, and even the Atlantic States, for produce to sustain life, which with little trouble, could be raised, of better quality and far cheaper, at their own doors." In the winter of 1853 Shelton was in New York City and delivered a specimen of the "California nutmeg" to John Torrey who must have informed Messrs. Parsons and Co. of Flushing. Without delay, Flushing sent a person to California "for the express purpose of collecting the ornamental and useful plants of that country" and returned with "ripe and fresh seeds" for propagation. Parsons Nursery had been founded in 1838 by Samuel B. Parsons (1819–1906).[7] We do not know how Torrey learned of "Prof. Shelton." Unfortunately no letters to or from Shelton have been located. We know from Josiah Hoopes's informative *Book of Evergreens* (New York, 1868) that Parsons had "undoubtedly" the best commercial collection of conifers. Incidentally, the enterprising William Lobb, then on the prowl for California novelties for Veitch, purveyor to English garden and greenhouse, noticed *Torreya* about the same time—perhaps as early as 1851—and sent specimens to England.[8] In the race to announce the new species, Torrey won with his publication of *Torreya californica* on February 3rd, 1854; William Jackson Hooker, who, evidently not knowing of the Shelton discovery, published *Torreya myristica* on May 1st! According to James H. Veitch, in his *Hortus Veitchii*, David Douglas had discovered the tree in the course of his travels in California some years before.

While on his visit in the East, Shelton visited a gentleman in Philadelphia who owned a large tract of land in California. He, in cooperation with a California landowner in New York, "entered into a very liberal arrangement" with Shelton, allowing him unrestricted permission to cultivate their lands for five years, providing cash for seeds, transportation back to California, and the salary of an experienced farmer to assist him—in short, all expenses. Shelton was to retain half of the profits. He arrived back in San Francisco in mid-February 1853. On April 4th there was held the first meeting of the California Academy of Natural Sciences at Lewis W. Sloat's office at 129 Montgomery Street. There is no record that Shelton was aware of the meeting. On April 11th he was a passenger on the steamboat *Jenny Lind* on its regular river run for Sacramento. "Just as she got abreast of the Pulgos Rancho, the plate on the after head

of her boiler blew out, sweeping away, in its course, and followed by the whole body of steam, the cabin bulk head and the exhaustion pipe of the engine."[9] The "dinner bell had just been rung" in the cabin, empty only five minutes before. The passengers had been seated and were in direct line with the boiler. Eighteen perished at once, including Shelton. Thirty persons were "badly scalded." Steamboat explosions were then only too well known. All, old and young, were known to be in danger of being scalded to death. After the tragedy Hutchings wrote that Shelton had "seemed about to realize the fulfillment of his cherished hopes, to reap the reward of his persevering efforts. . . Alas! Poor Shelton!"

It was the portrait reproduced here that J. M. Hutchings noticed in *Gleason's Pictorial Drawing Room Companion* (Boston) for Saturday, Sept. 16, 1854, page 165, that induced him to write about the late "Prof. C. C. Shelton." On the same page in the *Companion* is a drawing of the Mariposa Lily, *Calochortus*, correctly shown there as 3-petaled (note the error in the portrait!). We may assume that the artist was Paul Emert. The quotation accompanying the Mariposa on page 165 from a "San Francisco paper," which had appeared while Shelton was still alive, states that he travelled over the state more widely than we have otherwise learned. "He has done, and is doing more to develop the real resources of California, to promote her prosperity and add to the happiness of her citizens, than every quartz crushing machine, pick axe and long ton, from Klamath to San Diego."

What were Shelton's botanical records? The only record that Torrey had learned of the early death of Shelton is his reference to the "late Mr. Shelton" when he published in the *New York Journal of Pharmacy* 3 (1854) 49 on the discovery of the second species of *Torreya*. Why this notice was missed by William Henry Brewer when he summarized the collectors in the *Botany of California* (1880)[10] may have been due to not seeing that short article. *Torreya californica* represented the first Shelton collection to be reported upon by Torrey. Andrew D. Rodgers III,[11] telling the life of Torrey, adds another ingredient, the existence of a drawing of the California nutmeg. "About 1852 Lobb or one Shelton had found this tree in the Sierra Nevada, and drawing it, reported it to Torrey." Torrey reported that he had lately heard, surely through his correspondents in England, that Lobb had sent seeds to Veitch. But the drawing, if ever sent to Torrey, was not Shelton's but certainly Paul Emert's drawing made at Shelton's bidding.

Next, Torrey commemorated Shelton in the name *Monardella sheltoni*, 1855, but the Henry Pratten collection represents the type. For *Viola sheltoni*, 1857, it is John M. Bigelow's specimen which stands as the type. Torrey had labelled a Shelton collection "Gilia divaricata" noting only the general locality, "foothills of the Sierra Nevada." Later Asa Gray published Torrey's herbarium name in 1870.[12] Five of Shelton's collec-

tions, namely *Orobanche comosa* Hook., *Penstemon centranthifolius* Benth., *Cordylanthus filifolius* Nutt., *Monardella candicans* Benth., and *Pogogyne douglasii* Benth., are merely noticed in *Botany of the Mexican Boundary Survey*, and with minimal record of localities.[13]

QUERIES

1) Shelton's "herbarium consists of many thousands of pressed flowers. and where the originals could not be preserved, colored drawings[;] while he has procured, in person, specimens from almost every quartz vein in the strata" (Hayes, "California Notes I. 108, 1854–1856," Bancroft Library, Berkeley). Perhaps Shelton's dried plants were lost in the Sacramento flood of March, 1852, or the fire of November 3, the same year?
2) Rev. Frederic William Shelton (1815–1881), Episcopal minister in New York and Vermont, son of Nathan Shelton, M.D., published *Gold Mania*. Any possible connection with Prof. C. C. Shelton?
3) Shelton met Paul Emert (or Emmert) of New York City at Sacramento. According to Groce and Wallace, *Dictionary of Artists in America, 1564–1860* (Yale Univ. Press, 1957), the two artists Emmert and Penfield exhibited "Original Panorama of the Gold Mines" in New York City and elsewhere during 1850–51. J. R. K. Kantor, "Twelve drawings by Paul Emmert," *Bancroftiana* no. 60 (1975) 10–12, tells of his California days. Distinct but relevant art is a view of Downieville in 1856 done by Charles and Emil Dresel, reproduced by Joseph Henry Jackson, *Gold Rush Album* (Scribner's, New York, 1949), 212–213, where it is noted that "Necessary supplies were brought in from Marysville over seventy-odd miles of pack trails."

   Among the "phantom books" for which a California copyright was filed January 24, 1852, by "C. A. Shelton," no copy was located by Edith M. Coulter, *Calif. Hist. Soc. Quart.* 22 (1943): 33. One is entitled *Miners Prospecting and Miner's Cabin, Result of the Day (Lithograph engravings)* which would seem to relate also to Emert. Did Shelton and Emert collaborate on the "phantom books?" A note in the Almarin B. Paul (d. 1909) scrapbook at the Bancroft Library, Berkeley, reads that Emert "later went to Hawaii."
4) Now for the bryohistorian: Who was the "Mrs. Atwater" who collected *Bryum atwateriae* Müll. on "wet rocks at Yosemite Falls?" And who was "Mrs. J. Roy" who collected *Hypnum royae* Austin in "California?"

NOTES

1. J. H. Barnhart, *Biographical Notes upon Botanists* (New York, "1965" 1966) 3: 268, "Rev. Mr. Shelton" is based on a citation in *Bot. Calif.* (1876) 1: 58, followed by other

authors. Viola Brainerd Baird, *Wild Violets of North America* (Berkeley, 1942) 62, enlarges on "Rev. Mr. Shelton" with the statement that he botanized "about 1857" in California, but, as Elliott Coues would remark, she must have meant botanizing in the fields of asphodel. Prof. W. L. Jepson, who searched with limited success to identify Shelton, noted in his ms Field Books a reference to Margaret W. Johnson, *Our Methodist Pioneers* (Berkeley, 1938) 29. There will be found a sketch of "Rev. J. C. Shelton," relating that he "joined the gold rush" and lived in Grass Valley. This "Rev. J. C. Shelton" proves from the careful checking by Barney Lipscomb of Southern Methodist University, at my request, to be James Gilbert Shelton (1829–1897). His career may be traced in *Minutes of the Annual Conferences of the Methodist Episcopal Church, South*, from 1854 to 1897. He was not the "Prof. C. C. Shelton" who botanized for John Torrey.

2. Prospecting in libraries in the voluminous literature on the Gold Rush, just as with those fortunes sought among the Digger pines, yields ore of low value. W. P. Morrell, *Gold Rushes* (New York, 1941) Chap. IV. "California" with its bibliography is a good vein.
3. G. P. Fisher, *Life of Benjamin Silliman, M.D., LL.D.* (New York, 1866) **2**: 224–225.
4. J. Ewan, "San Francisco as a Mecca for Nineteenth Century Naturalists," in *Century of Progress in the Natural Sciences, 1853–1953*, ed., E. L. Kessel (San Francisco, 1955) 1–63, with roster of references to persons.
5. *Hutchings California Magazine* **3** (Oct. 1858) 172–176. The account is based on the meeting of Hutchings and Shelton in San Francisco in the winter of 1852. For life and writings of James Mason Hutchings (1818–1902), see F. P. Farquhar, *Yosemite, Big Trees, and the High Sierra* (Berkeley and Los Angeles, 1948) 18–21, 73–77, and Franklin Walker, *San Francisco's Literary Frontier* (New York, 1939) 28 *et passim*.
6. *The Alta California* (San Francisco) reported on October 4, 1851, that "Mr. Shelton, the botanist and mineralogist, has made the [Vigilance] Committee a valuable donation from his collection" toward a public library and museum *(Calif. Hist. Soc. Quart.* **28** (1949) 35).
7. U. P. Hedrick, *History of Horticulture in America to 1860* (New York, 1950) 245; and *New York Jour. Pharmacy* **3** (1854) 49, 51.
8. J. Ewan, "William Lobb, Plant hunter for Veitch and messenger of the Big Tree," *Univ. Calif. Publ. Bot.* **67** (1973) 21.
9. "Awful Steamboat Explosion!" *Alta California* (San Francisco) for April 12 (1853), p. 2, col. 3, where his name appears as "Mr. C. A. Shelton."
10. W. H. Brewer, "List of persons who have made botanical collections in California," *Botany of California* (1880) **2**: 553–559. This near classic account of wide usefulness does not mention Shelton—a singular fact when Brewer, who knew the gold district intimately, would be expected to have heard of Shelton and the tragedy of the *Jenny Lind*. Brewer's journals, excellently amplified by Francis P. Farquhar and published as *Up and Down California* (Yale Univ. Press, 1930), pay particular attention to plant lore.
11. Andrew Denny Rodgers III, *John Torrey. A Story of North American Botany* (Princeton Univ. Press, 1942) 242. C. S. Sargent, *Silva* (1896) **10**: 60, certainly misspelled the name as "Mr. Sheldon."
12. *Monardella sheltoni* Torr. in Durand, *Jour. Acad. Nat. Sci. Phila.* ser. 2. **3** (1855) 99. Carl Epling, monographer of the genus, selected the Pratten coll. from Nevada [City], Nevada Co., Calif. as the type, *Annals Missouri Bot. Gard.* **12** (1925) 50. *Viola sheltoni* Torr., Pacific RR. Rep. 4 (1857) 67. pl. 2, based on J. M. Bigelow coll. from Yuba River near Downieville, acc. W. L. Jepson, *Flora Calif.* (1936) **2**: 519. *Gilia divaricata* Torr. is now *Navarretia divaricata* (Torr.) Greene.
13. *Mexican Boundary Survey, Botany* (1859) **2**: 110, 115, 120, and 129. *Penstemon centranthifolius* may relate to Shelton's southern California visit, otherwise these species are associated with the plains and foothills of Sacramento.

SOME HEPATICAE COLLECTED BY DR. ROLAND THAXTER IN CHILE, 1905–1906

MARGARET FULFORD*

This report covers a part of the collection made by Dr. Roland Thaxter, Professor of Cryptogamic Botany, Harvard University, while on a trip to southern Chile, Punta Arenas, Corral and Concepción, in 1905–1906. Most of the thalloid species were determined by the late A. W. Evans of Yale University and were reported in a series of his papers (Evans 1923, 1925, 1927, 1930; *in* Herzog and Hosseus 1938). The specimens which he cited are in the Herbarium of Yale University (YU) and the Farlow Herbarium (FH). Most of the leafy species had not been determined, although a few are cited in monographs and manuals by various workers. Dr. Engel (1968) of the Field Museum, Chicago, has listed a species from this set in his monograph of *Balantiopsis*, and Fulford (1963–1976) cited species of several genera in her Manual.

Some 75 packets of Dr. Thaxter's collection at the University of Michigan Herbarium (MICH) were sent to me for study.** Most of these packets bear the original collection number but for those without them, new numbers enclosed in brackets [ ] have been given. Of the 64 species represented in this set 53 are leafy species and 11 are thalloid. They are listed below along with the localities where collected and the packet numbers.

LEAFY HEPATICAE

Adelanthus bisetulus (Steph.) Grolle. In mats with other bryophytes. Corral: *13, 117 p.p.*

Adelanthus lindenbergianus (Lehm.) Mitt. On humus. Punta Arenas: *115.*

Balantiopsis cancellata (Nees) Steph. On wood. Corral: *75, 96 p.p.*

Balantiopsis erinacea (Hook.f. & Tayl.) Mitt. On soil with other hepatics. Corral: *146 p.p.* (very poor). Engel (1968, p. 116) has also reported this species from packet no. *75.*

Bazzania nitida (Weber) Grolle. Corral: *20 p.p.*

Bazzania peruviana (Nees) Trevis. Over soil, rocks and bases of trees. Corral: *20, 35 p.p., 98 p.p., [157].*

Bazzania skottsbergii (Steph.) Fulf. Over other hepatics. Corral: *68 p.p., [158 p.p.].*

Cephaloziella exiliflora (Tayl.) Steph. On soil. Corral: *D, 55 p.p., [154].*

Clasmatocolea humilis (Hook.f. & Tayl.] Grolle. On a log with other bryophytes. Corral: *[159 p.p.].*

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**I wish to thank the University of Michigan Herbarium for the loan of this valuable material.

Clasmatocolea rigens (Hook.f. & Tayl.) Engel. On soil. Punta Arenas: *101 fide* Engel.

Clasmatocolea vermicularis (Lehm.) Grolle. On logs and soil. Corral: *96 p.p.* Punta Arenas: *152.*

Frullania arietina Tayl. On tree trunks. Concepción:*[160 p.p.].* Corral: *[159 p.p.].*

Frullania boveana Mass. On bark and over moss mats. Corral: *25, 68 p.p., 98 p.p., 117 p.p., [153 p.p.], [157 p.p.].*

Jamesoniella colorata (Lehm.) Schiffn. In mats with other bryophytes on soil, logs and trees. Corral: *68 p.p., 117 p.p., [153 p.p.].*

Jungermannia callithrix Lindenb. & Gott. On soil. Punta Arenas: *91 p.p.*

Jungermannia crassula Nees & Mont. On soil. Corral: *72, 94.*

Lepicolea ochroleuca (Spreng.) Spruce. In a moss mat on the ground. Corral: *117 p.p.*

Lepidolaena menziesii (Hook.) Dumort. On decayed logs, often in mats with other bryophytes. Corral: *45 p.p., 98 p.p., 117 p.p.*

Lepidozia chordulifera Tayl. On soil in mats with other hepatics. Corral: *20 p.p., 117 p.p., [157 p.p.].* Punta Arenas *56.*

Lepidozia cuspidata Steph. On soil and over logs with other hepatics. Punta Arenas: *53, 68 p.p., 100, 102.*

Lepidozia fuegiensis Steph. In mats with other bryophytes. Punta Arenas: *91 p.p., 102 p.p.*

Lepidozia laevifolia (Hook.f. & Tayl.) G.L.&N. In a mat with other bryophytes. Punta Arenas: *91 p.p.*

Leptoscyphus cuneifolius ssp. *fragilis* (Jack & Steph.) Grolle. On a log. Corral: *123.*

Leptoscyphus expansus (Lehm.) Grolle. In mats with other hepatics. Corral: *43.* Punta Arenas: *27, 50 p.p., 115 p.p.*

Lophocolea attenuatus Steph. Over logs and over other hepatics on soil. Corral: *33, 35 p.p., 103, 130, 134 p.p., [157 p.p.], [158].*

Lophocolea muricata (Lehm.) Nees. On fern fronds. Corral: *11C.*

Lophocolea semiteres (Lehm.) Mitt. Over logs. Corral: *125, 126.*

Plagiochila chilensis Steph. In bryophyte mats. Corral: *71, 98 p.p., 138, [157 p.p.].*

Plagiochila fuegiensis (Mass.) Besch. & Mass. Without locality: *1G.*

Plagiochila gayana Gott. In mats among other bryophytes. Corral: *20 p.p., 79 p.p.*

Plagiochila lechleri Gott. In mats of mosses. Corral: *68 p.p., 117 p.p.*

Plagiochila neesiana Lindenb. With other hepatics. Corral: *[157 p.p.].*

Plagiochila oligodon Mont. Over a log. Corral: *[158 p.p.].*

Porella chilensis (Lehm. & Lindenb.) Trevis. On trees. Concepción: *[163].* Corral: *48, 81, 98, 138, [161, 162].*

Porella subsquarrosa (Nees & Mont.) Trevis. On trees. Corral: *79, 98 p.p., 117 p.p.*

Radula decora Gott. On fern fronds and twigs. Corral: *11C,D p.p., 12A.*
Radula fernandezana Steph. On bark, often in mats with other bryophytes. Concepción: *14.* Corral: *117 p.p., 141 p.p.*
Radula flavifolia (Hook.f. & Tayl.) G. L. & N. On bark. Corral: *25 p.p.*
Radula hastata Steph. On trunks of trees and on twigs. Corral: *79 p.p., 127.*
Radula punctata Steph. On trees and in moss mats on logs. Corral: *40, 79 p.p., 98 p.p.*
Roivainenia jacquinotii (Mont.) Grolle. On soil with other hepatics. Punta Arenas: *53 p.p.*
Saccogynidium australe (Mitt.) Grolle. On a log. Corral: *96 p.p.*
Schistochila alata (Lehm.) Schiffn. In a bryophyte mat. Corral: *117 p.p.*
Schistochila lamellata (Hook.) Dumort. A mat on soil. Corral: *36.*
Schistochila reflexa (Mont.) Steph. Mats on decayed logs. Corral: *35 p.p., 45 p.p.*
Telaranea tetradactyla (Hook.f. & Tayl.) Hodgs. With other hepatics in a mat. Corral: *[157 p.p.]*
Trichocolea elegans Lehm. With other bryophytes in a mat. Corral: *117 p.p.*

LEJEUNEACEAE

Cololejeunea tortifolia Steph. On fern fronds. Corral: *11B.*
Harpalejeunea diversicuspis Steph. On wood with other hepatics. Corral: *109, [155, 159].*
Lejeunea corralensis Evans. On fern fronds and trunks of trees. Corral: *11 A–C p.p., 12 A*^{2}, *106, 138 p.p.* Evans (1930, p. 88) described this species from Dr. Thaxter's collections from Corral but did not cite a number for the type.
Lejeunea patigonica Steph. On leaves, fern fronds and trees. Corral: *2A, 11 A–C p.p., 11D.* Evans (1930, p. 85) cited Dr. Thaxter's collections in his description of the species without citing numbers.
Microlejeunea grandistipula Steph. With other hepatics on bark and logs. Corral: *104, 124 p.p., 141 p.p., [159 p.p.].*
Strepsilejeunea acuminata (Lehm. & Lindenb.) Steph. On trunks and branches of trees. Corral: *2, [156].*

THALLOID HEPATICAE

Metzgeria decipiens (Mass.) Schiffn. & Gott. On trees and logs and among other hepatics in mats. Corral: *34, 78, 110, 122, 124, 138, 141.* Evans (1923, p. 296) had cited *1f, 2c, 78, 110, 122, 124, 138, 141* from the Thaxter collections (FH, YU).
Metzgeria divaricata Evans. On soil and bark often with other hepatics. Concepción: *90* (portion of the type), *[156, 160].* Evans (1923, p. 288)

described this species from Dr. Thaxter's collection and cited *90* as the type (FH, YU).

Metzgeria epiphylla Evans. On fern fronds and on leaves. Corral: *11A, 11B p.p., 108*. Evans (1923, p. 303) described this species from Dr. Thaxter's collections and cited *10a* (the type), *108*, *140* (FH, YU).

Metzgeria violacea (Ach.) Dumort. In a bryophyte mat. Punta Arenas: *[159 p.p.]*—only a few scraps. Evans (1923, p. 307) cited *no.159* (FH, YU).

Pallavicinia xiphoides (Hook.f. & Tayl.) Steph. On soil. Punta Arenas: *28*.

Riccardia prehensilis (Hook.f. & Tayl.) Mass. In a mat with other hepatics. Corral: *98 p.p.* Evans (1921, p.117) cited *39*, *98* (FH, YU).

Riccardia conimitra (Steph.) Evans. On compact soil. Corral: *55*. This specimen was also cited by Evans (1921, p. 156) as *55 p.p.* (FH, YU).

Riccardia thaxteri Evans. On a log. Corral: *134*. Evans (1921, p. 126) cited *133* as the type (FH, YU).

Riccardia sp. Corral: *146*. Punta Arenas: *84*.

Symphyogyna circinata Nees & Mont. On soil. Concepción: *15*. This number was also cited by Evans (1927, p. 338) (FH, YU).

Symphyogyna rubritincta Evans. On soil. Concepción: *[164]*. Corral: *96 p.p.* Evans (1929, p. 39) cited numbers *21* from Concepción and *30*, *96*, and *120* from Corral (FH, YU).

Lunularia thaxteri Evans & Herzog *in* Herzog and Hosseus. On soil. Corral: *69*. The type came from Concepción. Hässel de Menendez (1962, p. 129) has considered it a form: *Lunularia cruciata* forma *thaxteri* (Evans & Herz.) Hässel.

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STUDIES ON LEJEUNEACEAE SUBFAM. PTYCHANTHOIDEAE VI. A REVISION OF SCHIFFNERIOLEJEUNEA SECT. SACCATAE FROM ASIA

S. Rob Gradstein and Lucie Terken*

SUMMARY

The originally monotypic eastern Malaysian genus *Schiffneriolejeunea* Verdoorn 1933 has now become a widespread, pantropical group of about fifteen species by the inclusion of species from the genus *Ptychocoleus* Trev. *nom. illeg.* Six species are known from Asia, three of which constitute the sect. *Saccatae* (Verdoorn) Gradst. & Terken *comb. nov.* These are the widespread *Schiffneriolejeunea tumida* (Nees) Gradst., the eastern Malaysian S. *cumingiana* (Mont.) Gradst. and S. *nymannii* (Steph.) Gradst. & Terken *comb. nov.* *Schiffneriolejeunea tumida* is a rather polymorphic species in which two not sharply defined varieties may be distinguished: *S. tumida* var. *tumida* with more or less involuted leaf margins, and *S. tumida* var. *haskarliana* (Gott.) Gradst. & Terken *comb. nov.* with plane margins.

The genus *Schiffneriolejeunea* was established by Verdoorn (1933) based on S. *omphalanthoides* Verdoorn, a robust "holostipous" species of Lejeuneaceae from the mountains of Celebes. *Schiffneriolejeunea omphalanthoides* is easily recognised by its rather long (up to 8 cm), sparsely branched, pendulous stems, which hang from branches of trees in upper montane forests, and by its narrow, bidentate leaf lobules which are completely hidden behind the very large, obcuneate underleaves. Five-keeled perianths are born on short-lateral *Lejeunea*-type branches, always without subfloral innovations. For a long time S. *omphalanthoides* was known only from the type locality (Celebes, Pik von Bonthain, leg. Warburg, FH) but recently collections have become available from other high mountain areas in eastern Malaysia, viz. New Guinea (Gradstein 1974) and Luzon, Philippines (Mizutani 1977).

In his classical treatment of the Asiatic *Ptychanthoideae*, Verdoorn (1934) juxtaposed *Schiffneriolejeunea* and the large pantropical, rather heterogeneous *Ptychocoleus* Trev. *nom. illeg.* (= *Frullanoides* Raddi). The senior author has shown recently (Gradstein 1974, 1975) that quite a number of species of *Ptychocoleus* Trev. are congeneric with S. *omphalanthoides* and should be transferred to the latter genus. Thus, *Schiffneriolejeunea* has now become a pantropical genus of about 15 species.

A total of 18 species of *Ptychocoleus* were recognised in Asia by Verdoorn (l.c.). Based on a study of the types, their placement should now be as follows:

1. *Ptychocoleus arcuatus* (Nees) Trev. ≡ *Acrolejeunea arcuata* (Nees) Grolle & Gradst.
2. *Ptychocoleus hians* Steph. = *Acrolejeunea arcuata* (Nees) Grolle & Gradst.
3. *Ptychocoleus cristilobus* Steph. ≡ *Caudalejeunea cristiloba* (Steph.) Gradst.
4. *Ptychocoleus pulopenangensis* (Gott.) Trev. ≡ *Schiffneriolejeunea pulopenangensis* (Gott.) Gradst.

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5. *Ptychocoleus grandiflorus* Herz. = *Schiffneriolejeunea pulopenangensis* (Gott.) Gradst.
6. *Ptychocoleus pycnocladus* (Tayl.) Steph. ≡ *Acrolejeunea pycnoclada* (Tayl.) Schiffn.
7. *Ptychocoleus mangaloreus* Steph. = *Schiffneriolejeunea pulopenangensis* (Gott.) Gradst.
8. *Ptychocoleus tjibodensis* Verdoorn ≡ *Acrolejeunea tjibodensis* (Verdoorn) Grolle.
9. *Ptychocoleus peradeniensis* (Mitt.) Steph. = *Schiffneriolejeunea tumida* (Nees) Gradst.
10. *Ptychocoleus validus* (Steph.) Verdoorn = *Schiffneriolejeunea nymannii* (Steph.) Gradst. & Terken.
11. *Ptychocoleus cumingianus* (Mont.) Trev. ≡ *Schiffneriolejeunea cumingiana* (Mont.) Gradst.
12. *Ptychocoleus haskarlianus* (Gott.) Steph. ≡ *Schiffneriolejeunea tumida* var. *haskarliana* (Gott.) Gradst. & Terken.
13. *Ptychocoleus tumidus* (Nees) Trev. ≡ *Schiffneriolejeunea tumida* (Nees) Gradst.
14. *Ptychocoleus sarawakensis* Steph. = *Schiffneriolejeunea tumida* (Nees) Gradst.
15. *Ptychocoleus fertilis* (Reinw., Bl., Nees) Trev. ≡ *Acrolejeunea fertilis* (Reinw., Bl., Nees) Schiffn.
16. *Ptychocoleus ustulatus* (Tayl.) Steph. = *Acrolejeunea fertilis* (Reinw., Bl., Nees) Schiffn.
17. *Ptychocoleus aulacophorus* (Mont.) Evans ≡ *Acrolejeunea aulacophora* (Mont.) Steph.
18. *Ptychocoleus brachiolejeuneoides* Verdoorn = *Mastigolejeunea recondita* (Steph.) Mizut.

Our revision shows that six species of *Schiffneriolejeunea* are now to be recognised in Asia: the very common *S. pulopenangensis* and *S. tumida* (both also widespread in the Pacific area), the eastern Malaysian *S. cumingiana*, *S. nymannii* and *S. omphalanthoides*, and the common Afro-American *S. polycarpa* which has now become known from Ceylon. *Schiffneriolejeunea cumingiana*, *S. nymannii* and *S. tumida* seem to form a rather natural group by the tendency of their leaf lobules to become involuted or revoluted at the base, developing a small sac. These three species may therefore be placed in a separate section for which the name *Ptychocoleus* sect. *Saccatae* Verdoorn is available.

TAXONOMIC TREATMENT

Schiffneriolejeunea Verdoorn sect. **Saccatae** (Verdoorn) Gradst. & Terken *comb. nov.*

≡ PTYCHOCOLEUS Trev. sect. SACCATAE Verdoorn, Ann. Bryol. Suppl. **4:** 137 (1934). TYPE SPECIES: *Ptychocoleus tumidus* (Nees) Trev. ≡ *Schiffneriolejeunea tumida* (Nees) Gradst.

= PTYCHOCOLEUS Trev. sect. MEDIAE Verdoorn, Ann. Bryol. Suppl. **4:** 134 (1934) *syn. nov.* TYPE SPECIES: *Ptychocoleus peradeniensis* (Mitt.) Steph. = *Schiffneriolejeunea tumida* (Nees) Gradst.

KEY

1. Lobule with 3–4 teeth ..... *2. S. cumingiana*
1. Lobule with 1–2 teeth 2
    2. Underleaves very broad, reniform, 2–3 × wider than long. Leaves ± flattened when moist, not squarrose ..... *3. S. nymannii*
    2. Underleaves narrower, at most 1.5 × wider than long. Leaves ± squarrose when moist ..... *1. S. tumida* 3
3. Ventral leaf margin and apex more or less involuted ..... *S. tumida* var. *tumida*
3. Leaf margins plane ..... *S. tumida* var. *haskarliana*

1. *Schiffneriolejeunea tumida* (Nees) Gradst., J. Hattori Bot. Lab. 38: 335 (1974); Gradstein & Inoue (1980) 28. Figure 1.

Ptychanthus tumidus Nees, Naturgesch. Eur. Leberm. 3: 213 (1838) ≡ *Phragmicoma tumida* (Nees) Nees & Mont., Syn. Hep.: 300 (1845) ≡ *Lejeunea tumida* (Nees) Mitt., J. Proc. Linn. Soc. Bot. 5: 111 (1861) *comb. illeg., non Lejeunea tumida* Mitt. 1855 ≡ *Ptychocoleus tumidus* (Nees) Trev., Mem. Reale Ist. Lomb. Sci. Mat. Nat., ser. 3, 4: 405 (1877) ≡ *Marchesinia tumida* (Nees) Kuntze, Rev. Gen. Pl. 2: 836 (1891) ≡ *Acrolejeunea tumida* (Nees) Schiffn. "Steph.," Hedwigia 33: 185 (1894). TYPUS: Malaysia, Pulo-Pinang, *Delessert* s.n. ex hb. Montagne (STR holo, G 15817, PC-MONT.).

Heterotypic synonyms:

Mastigolejeunea badia Gott. ex Steph., Spec. Hep. 4: 779 (1912) ≡ *Acrolejeunea badia* (Gott. ex Steph.) Steph. ex Verdoorn, Blumea 1: 230 (1934), *nom. inval, in synon.* ≡ *Ptychocoleus badius* (Gott. ex Steph.) Steph. ex Verdoorn, Ann. Bryol. Suppl. 4: 142 (1934), *nom. inval. in synon.* TYPUS: Solomon Is., Vanikoro, *Lesson* s.n. ex hb. Bescherelle (G holo not seen, BM, F).

Ptychocoleus borneensis Steph. ex Verdoorn, Ann. Bryol. Suppl. 4: 143 (1934), *nom. inval. in synon.* TYPUS: Borneo, Micholitz s.n. (G holo, FH).

Ptychocoleus grandifolius Steph., Spec. Hep. 5: 43 (1912). LECTOTYPUS: Solomon Is., *Micholitz* s.n. "c. per." (G 15624 holo).

Phragmicoma haskarliana Gott., Syn. Hep.: 299 (1845) ≡ *Lejeunea haskarliana* (Gott.) Spruce, Trans. & Proc. Bot. Soc. Edinburgh 15: 118 (1884) *"hasskarliana," comb. illeg., non Lejeunea haskarliana* Lehm., Pugillus 8: 26 (1844) ≡ *Acrolejeunea haskarliana* (Gott.) Schiffn., in Engler & Prantl, Natürl. Pflanzenfam. 1(3): 129 (1893) *ut "hasskarliana"* ≡ *Ptychocoleus haskarliana* (Gott.) Steph., Spec. Hep. 5: 44 (1912) *ut "hasskarliana"* ≡ *Schiffneriolejeunea haskarliana* (Gott.) Mizut. "Gradst.," J. Hattori Bot. Lab. 43: 134 (1977), *comb. inval. basion. non cit.* ut *"hasskarliana."* LECTOTYPUS: Java, *Hasskarl* 20 (B holo destroyed, isotypes in G 15638 & 15650, S, W—hb. Lindenberg nr. 6011, and ?FH (*Hasskarl* s.n.)). PARATYPUS: Java, *Hasskarl* 18 (G 14630, W—hb. Lindenberg nr. 6010).

Mastigolejeunea inflatilobula Steph., Spec. Hep. 6: 562 (1924), syn. *fide* Verdoorn (1934) 142.

Mastigolejeunea javanica Steph., Spec. Hep. 4: 778 (1912). TYPUS: Java, Tjipannas, *Fleischer* 13. VII. 1901 (G sub *Acro-Lejeunea javanica* St. n.sp.).

Lejeunea malaccensis Tayl., London Journ. Bot. 5: 392 (1846) ≡ *Ptychocoleus malaccensis* (Tayl.) Steph., Spec. Hep. 5: 47 (1912). TYPUS: Malaya, *Cantor* s.n. ex hb. Hooker (Holotype in FH-TAYL. not to be found, isotypes seen in BM, FH, NY, S, W).

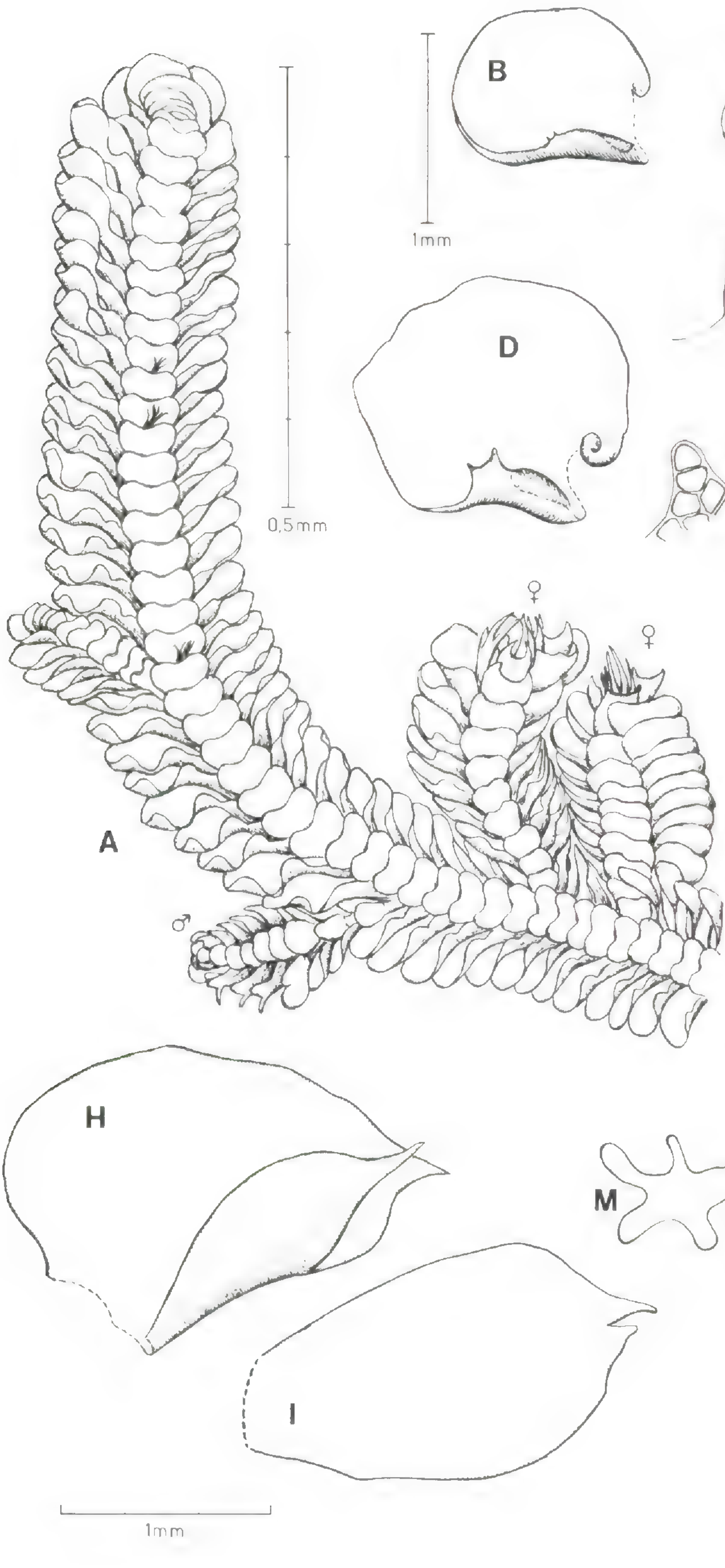
Acrolejeunea marquesana Steph., Hedwigia 34: 58 (1895) ≡ *Lejeunea* (subg. *Acrolej.*) *marquesana* (Steph.) Steph. in Bescherelle, J. Bot. 12: 4 (sep.) (1898) *ut "marquesiana"* ≡ *Ptychocoleus marquesanus* (Steph.) Steph., Spec. Hep. 5: 48 (1912). TYPUS: Marquesas Is., *Jardin* 395, ex hb. Berlin (G 15667 p.p.).

Acrolejeunea novaeguineae Steph., Denkschr. Akad. Wiss. Wien, Math. Nat. Kl. 81: 295 (1907) ≡ *Acrolejeunea novaeguineae* Steph., Hedwigia 28: 165 (1889), *nom. inval.* (Art. 43 ICBN) ≡ *Ptychocoleus novaeguineae* (Steph.) Steph., Spec. Hep. 5: 49 (1912). TYPUS: Australia, Queensland, Trinity Bay, *Sayer* s.n., 1866 ex hb. Melbourne (G 15681 holo, BM).

Lejeunea peradeniensis Mitt., J. Proc. Linn. Soc. Bot. 5: 111 (1861) ≡ *Phragmicoma peradeniensis* (Mitt.) Sande Lac., Ann. Mus. Bot. Lugd. Batav. 1: 307 (1864) ≡ *Acrolejeunea peradeniensis* (Mitt.) Schiffn., Consp. Hep. Archip. Ind.: 286 (1898) ≡ *Ptychocoleus peradeniensis* (Mitt.) Steph., Spec. Hep. 5: 54 (1912). TYPUS: Ceylon, Peradeniya, ad arbores, *Gardner* 1474 (NY holo, BM, FH, K). The type is a mixture of *S. tumida* and *S. pulopenangensis*, but Mitten's description and his original illustration accompanying the holotype clearly indicate that the present synonymy is correct.

Acrolejeunea rechingera Steph., Denkschr. Akad. Wiss. Wien, Math. Nat. Kl. 85: 195 (1910) ≡ *Ptychocoleus rechingeri* (Steph.) Steph., Spec. Hep. 5: 52 (1912). TYPUS: Solomon Is., Bougainville, Bucht von Kieta, *Rechinger* 4590 (G 15763 holo, W).

Brachiolejeunea retusa Horik., J. Sci. Hiroshima Univ., ser. B, div. 2, 2: 258 (1934), syn. *fide* Amakawa (1960) 363.


A
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0,5mm
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Ptychocoleus samoanus Steph., Spec. Hep. **5**: 53 (1912). TYPUS: Samoa, *Rechinger* s.n. (G 15764).
Ptychocoleus sarawakensis Steph., Spec. Hep. **5**: 53 (1912). TYPUS: Borneo, Sarawak, *Micholitz* s.n. (G 15766 holo, FH).
Ptychocoleus setaceus Steph., Spec. Hep. **5**: 54 (1912). TYPUS: Samoa, Savaii, Matantu, on stems of *Terminalia*, *Reinecke* 24 p.p. ("Fl. Samoensis"), IX. 1894, mixed with *Acrolejeunea aulacophora* and *Lopholejeunea* sp. (G 15801 holo, BM, FH, GRO, M).
Ptychocoleus squarrosifolius Steph., Spec. Hep. **5**: 55 (1912). TYPUS: Borneo, Sarawak, Lundu, *Micholitz* s.n. (G 15808 holo).
Ptychocoleus sumatranus Steph., Spec. Hep. **5**: 54 (1912) syn. *fide* Verdoorn (1934) 138.

Plants autoicous or dioicous, medium-sized to rather robust, up to 6 cm long, 2.5–3 mm wide, growing appressed to the substrate, green to yellowish-brown when living, becoming dull brown upon drying. Stem 0.25–0.35 mm in diam, in transverse section with 20–30 cortical cells surrounding 50–70 medullary cells, the cortical cells slightly larger than the medullary cells (especially dorsally), with brownish pigmented walls. Branching irregularly pinnate, the branches short and *Lejeunea*-type (often sexual) or long, vegetative *Frullania*-type.

Leaves densely imbricated, clasping the stem when dry, when moistened spreading and becoming squarrose, the dorsal insertion line covering the entire length of the merophyte. Lobe suborbicular to ovate, 1.2–1.8 × 1–1.5 mm, the dorsal base auriculate ("appendiculate"), the apex rounded, the margins entire, plane, concave or more or less rolled inwards especially along the ventral and apical margin, the ventral margin much shorter than the dorsal margin, making a wide margin (ca 150°) or an almost straight line with the keel; keel almost straight, at an angle of 45°–60° with the axis. Median lobe cells elongated-hexagonal, 25–35 × 15–20 μm, arranged in diverging rows, becoming larger towards lobe base and slightly smaller towards the margin; trigones medium-sized, becoming larger towards the lobe base, the intermediate thickenings variable in number (almost absent or 1–2 per cell in the longer cell walls). Oil bodies 4–8 per cell, rather coarsely granulose-papillose (*Calypogeia*-type).

Lobule ovate-rectangular, 0.35–0.7 × 0.2–0.3 mm, ¼–⅖ × lobe length, inflated along the keel, the free margin more or less inrolled (sometimes twice!) in the basal half of the lobule to form a closed sac, near the apex with (1–)2 teeth, the teeth variable in size, sometimes consisting of only one cell and barely discernible, sometimes large, triangular and clearly visible *in situ*, the first tooth often larger than the second tooth.

FIGURE 1. *Schiffneriolejeunea tumida* (Nees) Gradst. A. habitat (var. *haskarliana*). B–C. leaves (var. *tumida*). D. leaf (var. *haskarliana*). E. lobule teeth (var. *tumida*). F. lobule teeth (var. *haskarliana*). G. median leaf cell showing oil bodies (var. *haskarliana*). H–I. female bract and bracteole (var. *haskarliana*). K–M. cross sections of the perianth (var. *haskarliana*).
A from Samoa, *Schultze-Motel* 3153a. B, E from the type of *S. tumida*. C from the type of *Ptychocoleus sarawakensis* Steph. D, F, H–I, K–M from the type of *S. tumida* var. *haskarliana*. H from Samoa, *Schultze-Motel* 3821.

Underleaves imbricated, transversally obovate-obcordate, 3–5 × wider than the stem, 0.6–1.4 × 0.4–1.1 mm, the apex truncate but often recurved and seemingly retuse, the margins plane or rolled outwards, the bases cuneate, rounded or auriculate, the line of insertion arched, 0.2–0.4 mm deep.

Androecia on short lateral, *Lejeunea*-type branches, the bracts strongly inflated, hypostatic, smaller than vegetative leaves, in 3–11 series, each bract enveloping two antheridia. Gynoecia terminating short lateral branches, without innovations, the bracts in 3–6 series, becoming larger towards the perianth; inner bracts suberect, strongly concave, with margins plane or incurved, bifid to ½, ca 1.2–1.8 (–2.5) mm long, the lobule about as long as the lobe or shorter (up to ⅔); lobe suborbicular with minutely apiculate to elongated acuminate apex, the sinus narrow and acute, the lobule lanceolate, with acuminate apex and margins entire or with a few coarse teeth; inner bracteole obovate-subrectangular to suborbicular, about as long as the bract, ± gibbose, the margins plane or slightly recurved, entire or toothed above, the teeth variable, few and coarse or numerous and fine, the apex emarginate to bifid up to ⅙, the sinus narrow or rather wide, the lobes acute-acuminate. Perianth ca 1.5–2 mm long, obovate-obpyriform, never stipitate, immersed or exserted, with 3–5 inflated, smoothly rounded keels in the upper half and a short, inconspicuous beak.

Sporophyte with an articulate seta consisting, in cross section, of 16 outer cells and 4 inner cells. Capsule valves with a golden-brown fenestrate layer of thickening on the inner side, and 36 elaters (9 per valve), the elaters 300–400 μm long and ca 15 μm wide, each with one pale, sometimes rudimentary spiral. Spores angular, 40–50 μm in diam, green, their outer surfaces covered with numerous papillae and 6–8 rosettes made up of triangular spines.

Notes: Schiffneriolejeunea tumida is a very common epiphytic species occurring throughout Indomalaysia and the Pacific region, at altitudes ranging from sea level to 2000 m. A single record has become available recently from the Seychelles (Grolle 1978). It is usually found on bark of dead or living trees in forests, gardens, along roadsides, etc., but may also be seen on boulders and, rarely, on living leaves.

The species is easily distinguished by the leaves, which become squarrose when moistened and have lobules which are rather narrowly involuted (rarely revoluted!) with, especially in the lower half, a closed sac at the base, and have a bidentate apex. The female bracts and bracteoles are usually entire, but in some collections they tend to become denticulate, especially the inner bracteole. The size of the plants, as well as of the lobule teeth, varies remarkably, as was already noted by Verdoorn (1934), and in many specimens, especially in those with inrolled ventral leaf margins, the teeth become almost invisible. The degree of inrolling of

the leaf margin is another character in which much variation is observed, and previously this character was used as the main criterion to distinguish *Ptychocoleus haskarlianus* (margin plane) from *P. tumidus* and *P. sarawakensis* (margins involuted, especially ventrally and apically). Sometimes the underleaf margins are also voluted, but much less consistently than the leaf margins. Although we have long hesitated to distinguish the forms with or without involuted leaf margins as separate taxa, because of the presence of intermediates, we have finally come to the conclusion that it is possible to base two varieties on this single character: *Schiffneriolejeunea tumida* var. *tumida* for plants which have more or less involuted leaf margins (especially ventrally, sometimes also apically, in extreme forms also partly dorsally) and **Schiffneriolejeunea tumida** var. **haskarliana**[1] (Gott.) Gradst. & Terken, *comb. nov.* (*Phragmicoma haskarliana* Gott., Syn. Hep.: 299 (1845)) for the plants in which the leaf margins are plane, also ventrally. The var. *haskarliana* is apparently the most widespread variety, being common in Indomalaysia and the Pacific region, whereas the var. *tumida* is found only in Indomalaysia. Sometimes the two varieties are found growing together in the field, e.g. on Borneo (colls. *Mizutani*, NICH) where var. *tumida* is particularly common and shows extreme inrolling of the margins. Such forms were described as *Ptychocoleus sarawakensis* Steph.

Select specimens examined: SEYCHELLES: *Norkett* 17365c (hb Grolle, U). CEYLON: *Onraedt* 76.L.3329 (hb Grolle, hb Onraedt, U). SIKKIM: *Griffith* s.n. (G, K). ANDAMAN IS.: *Mann* div. colls. (BM, G, H, PC, S). NICOBAR IS.: *Kurz* s.n. (BM). THAILAND: *Tagawa* & *Kitagawa* 1329, 1409 (G); *Touw* 11285 (L). MALAYA: *Kurz* s.n. (BM,G). SINGAPORE: *Fleischer* 353 (NY). BANGKA: *Kurz* s.n. (BM). SUMATRA: *Schiffner* s.n., Hep. Sel. Crit. Verdoorn 272 (G, H, L, M, U); *Sipman* 6899 (U). JAVA: *Schiffner* s.n., Hep. Sel. Crit. Verdoorn 270, 271, 277 (BM, G, H, JE, L, M, MY, S, U, W). BORNEO: Kalimantan, *Meijer* 1558, 1579a, 1937, 2085a (L); Sarawak, *Richards* 2679 (K); Sabah, *Mizutani* 3027, 3085, 3086, 3247, 3948, 3949 (NICH). PHILIPPINES: Luzon, *Iwatsuki* & *Sharp* 13813, 17284, 16472 (NICH); Negros, *Merrill*, Bur. Sci. 6782 (PC); Mindanao, *Zwickey* 356, 593 (NICH, COLO). CELEBES: *Riedel* s.n. (BM, G, W). AMBON: *Zippel* s.n. (L). NEW GUINEA: West Irian, *van Zanten* 175a, 184 (JE, L); Papua, *Schuster* 67–5861, 5862 (JE). AUSTRALIA: Queensland, *Sayer* s.n. (G, BM). SOLOMON IS.: *Micholitz* s.n. (BM, G, JE). NEW CALEDONIA: *Hürlimann* 1951, 2012, 2189, 2247a, 2248, 2269a, 2274, 2660, 2827 (hb Hürlimann, U). NEW HEBRIDES: *Joly* s.n. (G). TONGA: *Hürlimann* 808a (hb Hürlimann, U). SAMOA: *Rechinger* 2729, 3191, 3200 (W); *Schultze-Motel* 3153a, 3821 (B, JE, U). CAROLINE IS.: Kusaie, *Pashinsou* s.n. (G). SOCIETY IS.: Tahiti, *Hürlimann* T 1213 (hb Hürlimann, U). MARQUESAS IS.: Nuku Hiva, *Jardin* 395 (G).

Schiffneriolejeunea tumida has furthermore been reported from Okinawa, Japan (Amakawa 1960, sub nom. *Ptychocoleus hasskarlianus*) and probably from Vietnam (Pócs 1965, sub nom. *Ptychocoleus cumingianus*, collection not seen).

2. *Schiffneriolejeunea cumingiana* (Mont.) Gradst., J. Hattori Bot. Lab. 38: 335 (1974). Figure 2, A–B

Phragmicoma cumingiana Mont., London J. Bot. **4**: 7 (1848/January) ≡ *Lejeunea cumingiana* (Mont.) Mitt., J. Proc. Linn. Soc. Bot. **5**: 111 (1861) ≡ *Ptychocoleus*

[1] Usually spelled "*hasskarliana*," but the original spelling "*haskarliana*" is to be retained. The full synonymy of this taxon is given under the species.

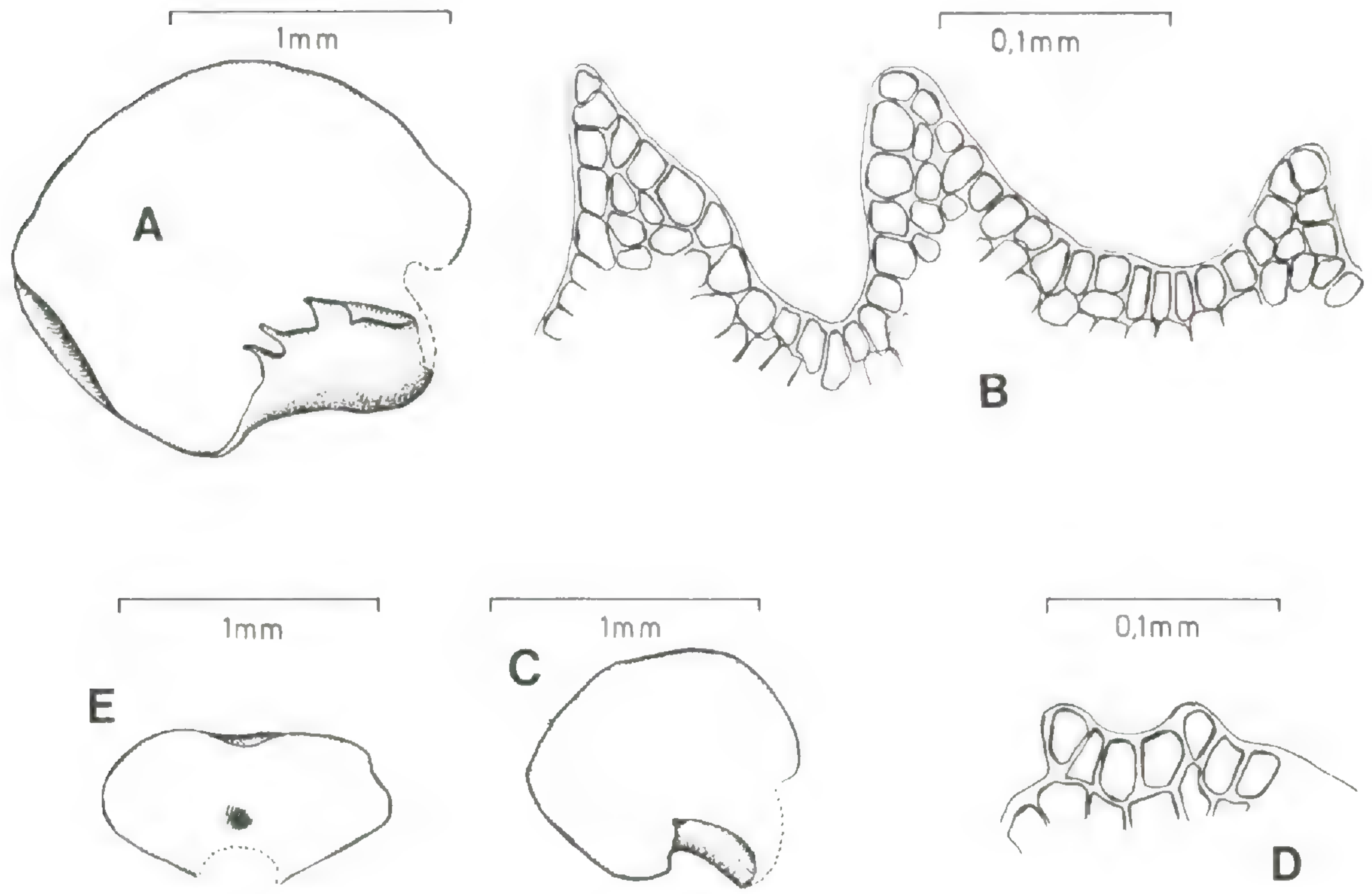

FIGURE 2. A–B. *Schiffneriolejeunea cumingiana* (Mont.) Gradst. A. leaf. B. lobule teeth. C–E. *Schiffneriolejeunea nymannii* (Steph.) Gradst. & Terken. C. leaf. D. lobule teeth. E. underleaf. A–B from the type of *S. cumingiana*. C–E from New Guinea, *Schuster* 67-5862a.

cumingianus (Mont.) Trev., Mem. Reale Ist. Lomb. Sci. Mat. Nat., ser. 3, **4:** 405 (1877) ≡ *Marchesinia cumingiana* (Mont.) Kuntze, Rev. Gen. Pl. **2:** 836 (1891) ≡ *Acrolejeunea cumingiana* (Mont.) Schiffn., Consp. Hep. Archip. Ind.: 283 (1898). TYPUS: Philippines, *Cuming* 2189 (PC-MONT. holo, BM, G 15576).

Heterotypic synonym:

Acrolejeunea luzonensis Steph., Hedwigia **34:** 57 (1895) ≡ *Ptychocoleus luzonensis* (Steph.) Steph., Spec. Hep. **5:** 47 (1912). TYPUS: Philippines, Luzon, *Micholitz* s.n. (G 15663 holo).

Plants autoicous or dioicous, medium-sized to rather robust, up to 5 cm long and 3 mm wide, growing appressed to the substrate, brownish when dry. Stem 0.2–0.3 mm in diam, the branching as in *Schiffneriolejeunea tumida*.

Leaves densely imbricated, clasping the stem when dry, when moistened spreading and becoming squarrose. Lobe orbicular to subovate, 0.9–1.6 × 0.9–1.3 mm, the dorsal base auriculate, the apex rounded, the ventral and apical margin usually rolled inwards, the ventral margin forming an almost straight line with the keel; cells as in *S. tumida*, but intermediate thickenings rare. Lobule obscure, hidden by the inrolled ventral margin of the lobe, when spread out ovate-rectangular, 0.5–0.6 × 0.2–0.35 mm, the free margin nearly always rolled outwards in the basal half of the lobule, sometimes subsequently becoming inrolled again but never forming a closed sac, near apex with 3–4 large teeth, the teeth 5–12 (!) cells long, narrow triangular, each tooth tapering into a uniseriate point of 2–3 cells, the 3rd (4th) tooth often smaller than the others.

Underleaves imbricated, transversally obovate-obcordate, 0.6–0.9 × 0.4–0.65 mm, the apex truncate or recurved-retuse, the margins plane or recurved, the bases cuneate or rounded, sometimes auriculate, the insertion line arched.

Gametoecia as in *Schiffneriolejeunea tumida*.

Notes: Schiffneriolejeunea cumingiana was confused by Verdoorn (1934) and most other authors with the very common *S. tumida*, especially with its var. *haskarliana*. The type collection of *S. cumingiana* (Philippines, *Cuming* 2189, PC-MONT.) is very different from *S. tumida*, however, by the presence of three, instead of two, lobule teeth. Moreover, the free margin of the lobule is revoluted near the base instead of involuted and, consequently, does not develop a closed sac. Otherwise the two species are quite similar. The size of the lobule teeth in *S. cumingiana* varies although they never become as small as in *S. tumida*. An extreme form in this respect is the specimen from Borneo (Pulau Laut, *Meijer* 3265, L), which has four very large, conspicuous teeth up to 12 cells long! Three to four lobule teeth may also be found in the common Indomalaysian *S. pulopenangensis*, but the species is easily distinguished from *S. cumingiana* (and from *S. tumida*) by the leaves and lobules being flattened, not squarrose when moist. *Schiffneriolejeunea cumingiana* is thus far only known from eastern Malaysian islands, where it occurs epiphytically not far from the coast, probably at low elevations only.

Specimens examined: BORNEO: Pulau Laut, *Meijer* 3625 (L). CELEBES: Tambea, *Westenberg* s.n. (GRO); Mondeodo, *Eyma* 3729 (GRO). PHILIPPINES: without loc., *Cuming* 2189, type (FH-TAYL., G, NY, PC-MONT., W); Luzon, *Micholitz* s.n. (G); Dapitan, *Micholitz* s.n. (G); Mindoro, *Micholitz* s.n. (G); Papahog Is., Tawi Tawi group, *Bartsch* 169a (NICH); Palawan, Tay Tay, *Merrill* s.n., Bur. Sci. 1692 (FH). CERAM: *Dörfler* s.n. (S). NEW GUINEA: Doom Is. near Sorong, *van Hellendoorn* 98b (L).

3. **Schiffneriolejeunea nymannii** (Steph.) Gradst. & Terken, *comb. nov.*
Figure 2, C–E

Archilejeunea nymannii Steph., Spec. Hep. **4:** 730 (1911). TYPUS: Papua New Guinea, "Kaiser Wilhelmsland: Sattelberg," *Nyman* s.n., 1899 (G holo, FH).

Heterotypic synonyms:

Mastigolejeunea valida Steph., Spec. Hep. **4:** 772 (1912) *"superae"* pro err., fide *l.c.* p. 824 ≡ *Ptychocoleus validus* (Steph.) Verdoorn, Ann. Bryol. Suppl. **4:** 136 (1934).

Ptychocoleus longispicus Steph., Spec. Hep. **5:** 46 (1912). TYPUS: Borneo, Sarawak, "Suan," *Micholitz* s.n., 1894 (G holo, FH). [The locality has also been incorrectly cited for the Philippines cf. Stephani, Spec. Hep. **4:** 772]

Ptychocoleus flaccidus Steph., Spec. Hep. **5:** 43 (1912). TYPUS: New Guinea, without loc., *Micholitz* s.n. (G 15621, 15622).

Plants dioicous, medium-sized to rather small, up to 3 cm long and about 2 cm wide, growing appressed to the substrate, brownish when dry. Stem 0.18–0.25 mm in diam, the branching as in *S. tumida*.

Leaves densely imbricated, clasping the stem when dry; when moistened spreading but not/hardly becoming squarrose. Lobe ovate, 1.2–1.5

× 0.8–1 mm, the dorsal base not/weakly auriculate, the apex rounded plane or slightly incurved, the margins entire, not incurved, the ventral margin sometimes crispate-undulate, forming a sharp angle of ca 90°–130° with the keel; median cells ca 25 × 16 μm, the trigones rather small and the intermediate thickenings rather frequent, 1–2 per cell on the longer walls.

Lobule ± narrowly rectangular, 0.5 × 0.2 mm, the free margin near the base ± inrolled and saccate, sometimes only weakly so, near the apex with 1–2 very small, one-celled, erect or incurved teeth which are separated about three or four cells from each other.

Underleaves imbricated reniform, 0.9–1.4 × 0.5–0.6 mm, 5–6 × stem width, the apex truncate to recurved-retuse, the margins plane or weakly recurved, the bases cuneate or rounded, not or minutely auriculate, the insertion line arched.

Androecia as in *Schiffneriolejeunea tumida*. Gynoecia terminating short lateral, *Lejeunea*-type branches, rarely with an innovation of the *Radula*-type (then archegonium not fertilized!), the bracts and bracteoles in two series only, much larger than leaves and underleaves, with entire margins; inner bracts strongly concave, spreading above, the inner bract wider than long, very slightly bifid only, ca 1.8 mm long, the margins curved upwards and widely enveloping the perianth, the lobule subequal to the lobe, their apices ± narrowly obtuse and the sinus very shallowly obtuse; inner bracteole almost orbicular, ca 1.5 mm long, deeply concave with incurved margins which are enveloping the perianth, the apex rounded to minutely bifid.

Perianth obpyriform, ca 1.8 mm long, weakly exserted, with 5 inflated, smoothly rounded keels in the upper half and a short inconspicuous beak about 3 cells long.

Notes: Schiffneriolejeunea nymannii is an apparently rare eastern Malaysian species, thus far only known from a few localities in the lower mountains of New Guinea (up to 1500 m) and Sarawak, Borneo. The species habitually resembles small phases of *S. tumida* from which is differs, however, by the leaves which remain ± flattened when moist instead of becoming squarrose. In this respect, *S. nymannii* approaches *S. pulopenangensis*. Other differences separating *S. nymannii* from *S. tumida* are: 1) the ± ovate leaves with plane sometimes crispate-undulate ventral margins, long and narrow lobules with minute teeth and, most characteristically, the sharp angle between the ventral leaf margin and the keel (angle much wider in *S. tumida*); 2) the much broader, reniform underleaves, and 3) the very different gynoecium, which has only two series of bracts and bracteoles (3–6 in *S. tumida*), minutely bifid bracts with obtuse apices (± acuminate in *S. tumida*) and a broader, almost orbicular bracteole, which is much more strongly concave as to closely

envelop the inflated perianth (as in *Acrolejeunea pycnoclada* and *Schiffneriolejeunea pappeana*!).

Specimens examined: in addition to the type specimens from the Stephani herbarium cited above, only a single specimen of *Schiffneriolejeunea nymannii* has become available – Papua New Guinea: Wau Distr., Kunei Creek, near Edie Creek SSW of Wau, *Schuster* 67–5862a, 25.V.1967 (JE).

ACKNOWLEDGMENTS

This paper is dedicated to Dr. Geneva Sayre who, by her papers on the location and identity of authentic herbarium specimens and exsiccatae, has made life so much easier for the taxonomist.

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RETRIEVAL WORKS USEFUL TO THE BRYOLOGICAL TAXONOMIST

S. W. Greene*

SUMMARY

An annotated resume is provided of works which allow rapid and easy access to source materials of importance to the bryological taxonomist. The works are considered in two categories, the first, specimen retrieval and the second, literature retrieval. Attention is drawn to some gaps in the aids currently available for recovering pertinent data.

It is self-evident that as the body of information on a subject increases, so too does the need for bibliographies, cross reference systems, indices etc. Bryologists have a need for works of this sort; the purpose of the present paper is to review some of the aids available as well as to discuss others which could be of value.

GENERAL WORKS

The best known and most widely used general work is *Biological Abstracts* (1926–to date) which, through its detailed classification of contents, gives access to literature on a wide variety of topics although its coverage of works on the taxonomy of the bryophytes is not comprehensive. *Excerpta botanica* Sect. A. *Taxonomica et chorologica* (1959–to date), with a much simpler classification of contents, is more useful to the bryological taxonomist, but the *Kew record of taxonomic literature* (1971–to date) is of no value since it only covers literature pertaining to vascular plants. The index to American botanical literature, including that of Oceania, published in the *Bulletin of the Torrey Botanical Club* (1881–1946 as a single consolidated list covering all plant groups; from 1947–to date subdivided into plant groups), although strictly a regional list, is of considerable value in view of the extent of the area it covers.

Two other general works valuable for indicating likely new routes into source material are Swift's (1970) *Botanical bibliographies* and *Walford's guide to reference material ed. 4* (Walford, 1980). Both are comprehensive in treatment with good cross referencing and excellent annotations. Swift's work has many direct references to bryological publications, and although Walford's does not, its clear layout makes it easy to consult and to arrive at a quick assessment whether a particular work is likely or not to be worth following up—it is surprising how many are.

In passing, attention should be drawn to Boivin's (1977 a, b) proposal for *A basic bibliography of botanical biography and a proposal for a more elaborate bibliography*. If these proposals lead to the publication of the comprehensive work the author outlines, taxonomists could get a retrieval

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aid of great value. Unfortunately, it is not clear whether the intention is to restrict the bibliography to works on vascular plants or whether all categories of plants will be included.

Bryologists are fortunate in that, from the start of publication, three of the current bryological journals have included extensive bibliographies in virtually every volume covering many aspects of the subject. They are: the *Bryologist* (1898–to date); the *Journal of Bryology* (1972–to date, formerly the *British Bryological Society Reports* 1922–1945, later the *Transactions of the British Bryological Society* 1947–1971) and *Cryptogamie. Bryologie Lichénologie* (1980, but from 1874–1929 under its better known name of the *Revue bryologique* and the *Revue bryologique et lichénologique* 1930–1979). Although they have never been indexed and some only subdivided into the broadest of categories, these bibliographies provide a good basis for a general bryological bibliography for the 20th Century.

Recently, the Library of the Komarov Botanical Institute, Leningrad, has started to publish a wide-ranging bibliography of bryophytes. Three volumes have appeared so far under the title *Katalog Literatury po Mochoobraznym (Bryophyta)* by Tsvetkova and Kryukova (1975, 1976, 1977), and were reprinted in one volume by Otto Koeltz Science Publishers, Koenigstein, B.D.R. as *Collectanea bibliographica* Vol. 11, 849 pp, 1978. All aspects of bryology are covered, and at the end of each original volume there is a list of the journals used for reference. Unfortunately for users the entries, which are arranged in their original language in a single alphabetical series in each volume, are not classified. Nevertheless for the period 1946–75 this work, taken in conjunction with the bibliographies in the standard journals mentioned above, provides bryologists with an excellent introduction to many aspects of their subject.

Coverage for the 19th Century is much less complete. Underwood (1892) has given a reasonable introduction to the hepatic literature for much of the period, and Steere (1955) has well reviewed the development of bryology as a whole from 1853 to 1953. The early part of the 19th Century and the latter half of the 18th Century, two important periods taxonomically both because of the number of "new" species described and because the nomenclatural starting dates for the group fall within it, are rather better covered by Sayre (1959), Margadant (1968), and Henrey (1975).

SPECIMEN RETRIEVAL

General collections

Unquestionably the single most important source of information for the taxonomist is the plant material—whether living or in herbarium collections. Although some mimeographed lists have been circulated, to the author's knowledge, no serious attempt has yet been made to disseminate information about what is available in living collections of bryophytes. It

will probably be quite some time before bryologists see this as a serious omission. There are signs of increasing awareness of the need for conservation measures, especially concerning the rate of habitat losses in the tropics. Any loss of variability in the genetic pool is to be deplored, particularly when the plants have not been subjected to pharmacological screening or other tests for value to mankind.

By way of contrast, two comprehensive international guides to the contents of herbaria are available. *Index herbariorum Pt. 1 – The herbaria of the world* (Holmgren and Keuken 1974), which is also the source of the alphabetical code letters by which herbaria are normally cited, describes the contents of herbaria under an alphabetical list of the cities and towns in which they are located. Important regional or nomenclaturally significant collections of bryophytes are noted. In *Index herbariorum Pt. 2 – Collectors* (Lanjouw and Stafleu 1954, 1957; Chaudhri, Vegter and de Wal 1972; Vegter 1976), the locations of collections are detailed in alphabetical order of collectors; the *Index* so far published extends from A to the end of M.

From the point of view of bryologists, a more detailed treatment will be found in Iwatsuki, Vitt and Gradstein (1976) which is arranged similarly to *Index herbariorum Pt. 1.* For one reason or another, several herbaria with important bryological collections appear in neither of these works (Holmgren and Keuken 1976). Even if Iwatsuki, Vitt and Gradstein had provided an index to their work – which would have been an index of collectors but was omitted, according to S. R. Gradstein (personal communication), because it was considered that Sayre's (1977) valuable alphabetical list of *Authors of names of bryophytes and the present location of their herbaria* would give all that was required – it would still not help the working taxonomist to answer quickly and easily two of his commonest questions: 1) where is the type of. . .?, and 2) where can I find more material from. . .?

To consider the geographical problem first, it seems that no one has yet provided a satisfactory way of answering this question. Some form of Electronic Data Processing (EDP) seems to be the best long-term solution. These systems have the necessary flexibility to hold substantial detail about individual specimens. This detail may be aggregated under successively coarser groups of co-ordinates to provide summaries at the level of county, province, state or country as required. Experience with the data bank associated with AAS (Greene 1972, Greene and Greene 1975) has shown that listings by county or region not only tell what has been collected but also what areas have been neglected. Moreover an indication of general representation of a taxon in a collection may be obtained. It has proved invaluable as an aid to planning field expeditions in Antarctic regions.

The difficulty of keeping track of unworked-up or incompletely laid-in

material is another of the unresolved problems with which the taxonomist has to grapple. The current "word of mouth" system is likely to come under increasing strain as "fire brigade" operations are mounted to secure specimens from areas about to vanish under bulldozers and excavators. So far, no serious debate has been held about the best way of listing such material, its existence being rarely mentioned in Holmgren and Keuken (1974) or Iwatsuki, Vitt and Gradstein (1976). Some form of rapid accessioning procedure seems to be what is required. A practice which is now standard procedure in AAS, at least for handling mosses, could be of value. As soon as an unidentified collection is received, a preliminary determination list is prepared. This includes final determinations to species for those specimens which can be identified "on the spot" by checking a slide or specimen—identifications which do not necessitate lengthy study or comparison with reference material. Only generic names are given to the specimens requiring further work. If there is uncertainty about the genus, a number of holding groups ending in -oid are used. After input to the data bank, a suitable printout will show at a glance how much material of any genus is available and how much of it has been fully determined etc. Instead of leaving collections aside which cannot be reasonably determined because of the absence of a specialist or suitable revisions, the allocation of specimens to genera allows the existence of incompletely worked-up material to be recorded. This moves away from a system where such material is noticed only if the person who knows about it is "in" on the day a query is raised.

The system works well in AAS—a small specialized regional herbarium. What would be of great help to curators attempting to put such methods into general practice with material from all over the world would be synoptic definitions and keys, preferably in the English language, to all the genera of mosses and hepatics which have been described. According to R. M. Schuster (personal communication), he has such a synopsis prepared for the genera of hepatics, and it will be included in his long projected treatment of the group in *Die natürlichen Pflanzenfamilien*. M. C. Crosby (personal communication) is hoping to do something similar based on the listing of genera in the *Dictionary of mosses* (Crosby and Magill, 1977).

Type material

Although there is universal agreement among bryologists that a register of type specimens (including kleptotypes?) is essential, there is no real agreement about how much is required or how it may be achieved. Some system based on EDP methodology seems to be the best answer, but most people are put off by what are regarded as formidable costs. Another major problem is seen in the time it would take curatorial staff to abstract the necessary label data. Greene (1972) and Greene and Greene (1975)

showed that these problems need not be as great as imagined and gave examples of specimen listings, synonymy lists etc. which can be obtained from the files of the AAS data bank.

For the moment the best answer seems to lie in personal initiative; three striking examples of what can be achieved may be mentioned. Clarke (1973) provided a listing of the moss types in MANCH (estimated to have ca 500,000 bryophyte specimens). Hattori and Noguchi (1960) gave a list of the types of mosses and hepatics in Japanese herbaria. Pócs (1976–77) has catalogued the 292 bryophyte types in EGR. A number of catalogues, prepared under the supervision of Geneva Sayre, are available to various types in FH. To date these include indices to the Schiffner Moss and Hepatic Herbaria, Fleischer Moss Herbarium, the Thomas Taylor Moss Herbarium, and the Sullivant Hepatic Herbarium. There is also an index to the Bartram Herbarium. Eddy, Harrington and Ellis (1980) have started to list the bryophyte types in BM.

A reference to a single author type register of Kindberg material by Steere and Crum (1977) will be found below on p. 90.

Brummitt (1979) has reported on a trial carried out under the aegis of AETFAT (Association pour l'Étude Taxonomique de la Flore d'Afrique Tropicale) to produce a type register of African Ranunculaceae based on photographs of relevant specimens from 30 herbaria. Although similar photographs of bryophyte specimens would have only limited value, a photograph of labels could be of considerable interest, particularly if assembled in one center. Copies could be made generally available to bryologists. It could also have the advantage of making data capture for an EDP system that much easier, particularly once a substantial body of photographs had been built up.

Exsiccatae, collectors and writing

There is one other method which taxonomists rely on to disseminate information about taxa and to facilitate the recovery of the material. This involves the issuing of a number of duplicate sets of dried specimens—an exsiccata—usually provided with printed labels serially numbered from one onwards and often accompanied by a published list of the contents of the sets. The bryological world is fortunate to have an excellent guide to such collections in the form of Sayre's (1969–75) *Cryptogamae exsiccatae —An annotated bibliography of exsiccatae of Algae, Lichenes, Hepaticae and Musci.* It is in five parts, part IV dealing exclusively with bryophytes. The work is a "veritable mine" of information regarding the exsiccatae themselves since it provides titles, place and date of publication, details of fascicules where appropriate, reference to indices and reviews, details of labels etc. It also gives valuable biographical information about many of the collectors, their dates, main expeditions, and much else besides and it includes collectors who have issued sets of specimens which do not qualify

for one reason or another as an exsiccata.

Attention should also be drawn to another of Sayre's works—the *Authors of names of bryophytes and the present location of their herbaria* (Sayre, 1977). This is really an update of the bryophyte portion of Sayre, Bonner and Culberson (1964) *The authorities for the epithets of mosses, hepatics and lichens*. It is basically an alphabetical list of names with dates of birth (and death for those deceased) and abbreviations of the names. It is also a valuable source of data on the whereabouts of their herbaria. Already this list is making a useful contribution towards the stabilization of abbreviations of authors' names when associated with the names of genera and species.

Finally one other catalogue should be mentioned in this section. As it stands, it contains only a small amount of information of relevance to the bryologist but its value to phanerogamists is great, and it is to be hoped that it will be taken up and developed by bryologists. The catalogue in question is by Burdet (1972–79) and is entitled *Cartulae ad botanicorum graphicem*. It is in fifteen parts. The demand for reprints proved so great that it has been reissued as a single volume under the new title of *Auxilium ad botanicorum graphicem* (Burdet, 1979). The work is an alphabetically arranged set of specimen handwritings of 18–20th Century botanists and is based on files in Genève started by A. P. de Candolle. Some people who made notable—even notorious—contributions to bryology are represented e.g. B. Carrington (1827–1893); J. D. Hooker (1817–1911); F. J. H. "Baron" von Müller (1825–1896); A. M. F. J. Palisot de Beauvois (1752–1820); G. Raddi (1770–1829); and J. C. Schleicher (1768–1834).

LITERATURE RETRIEVAL

If specimen retrieval is fraught with difficulties literature retrieval can be even more so! This is true not only because of the multiplicity of languages but also because many older works were published in limited editions in obscure places and, as a consequence, are poorly represented even among the larger libraries. By virtue of the nature of his work, the taxonomist may require immediate access to virtually any serial or book that has ever been published on the taxonomy of bryophytes. Of particular significance in this respect are the provisions of the *International code of botanical nomenclature*, the most recent edition being that agreed in Leningrad in 1975 (Stafleu 1978). As is well known, the *Code* is a sophisticated set of Articles and Recommendations which often necessitate that the taxonomist, striving to keep within their provisions, consult some rare work dealing with the bryoflora of a part of the world with which he is not directly concerned because of a question of synonymy, nomenclatural priority or some other issue. Fortunately, the last 20 years

have seen the appearance of a number of works which go a long way towards facilitating the search for what is required.

Descriptions of species

Pride of place among the guides, indices, etc. must surely go to *Index muscorum* (Van der Wijk, Margadant and Florschütz, 1959–69) and *Index hepaticarum* (Bonner, 1962–76). These are two great alphabetical indices designed to provide a rapid route to the original place of publication of the descriptions of taxa. In the case of *Index hepaticarum* information regarding the all important nomenclatural type is also included. There is ample evidence that, even in the short time since their publication, they have greatly facilitated much taxonomic work.

The value to vascular plant taxonomists of the *Index kewensis* and its regular supplements had long been apparent so it was only a question of time until bryologists produced something of their own. Around the turn of the century, two indices to bryophyte taxa had appeared—an *Index bryologicus* which treated mosses and ran to two editions (Paris, 1894–98, 1900, 1904–06, 1909) and Stephani's (1898–1917, 1924) *Species hepaticarum*. But there was criticism of both works, particularly of the *Species hepaticarum*. No effort was made to keep them up to date. During the 8th International Botanical Congress in Paris in 1954, it was resolved to make a fresh effort, the result being the 5-volume *Index muscorum* (Van der Wijk, Margadant and Florschütz, 1959–69) and the eight parts of the *Index hepaticarum*, all that had been published by Bonner (1962–76) before his death in 1976. A group of bryologists under Mme Bischler's direction are currently working to complete this Index (Bischler 1977). An 11-year supplement to the *Index muscorum*, 1963–1973 (the closing date for entries to *Index muscorum* according to the postscript to Vol. 5 was 1 January 1963) is being prepared.

A word of warning must be sounded as regards the use of dates to literature cited in the *Index muscorum*. Throughout that work the effective date has been cited, not the bibliographic date (W. D. Margadant personal communication). Since it is the bibliographic date linked to the volume number—especially in the case of serials—which is used in library recovery systems, untold confusion and frustration can result if the date is overemphasised to the neglect of the volume number. So far no bibliography has been published for *Index muscorum* but if one were issued, and it showed for each reference the effective as well as the bibliographic date where they differed, it would remove much of the confusion. In passing it may be mentioned that the system of citing the bibliographic date after the author's name and following that by the effective date where it differs, in square brackets, as has been adopted by Stafleu and Cowan (1976, 1979a), has a very great deal to commend it as a standard procedure.

As a result of an initiative by the International Association of Bryolo-

gists, there will appear in *Taxon* two-year supplements to *Index muscorum* and *Index hepaticarum*. Three have already been published viz *Index muscorum supplementum* 1974–1975 (Crosby, 1977); *Index hepaticarum supplementum* 1974–1975 (Engel, 1978) and *Index muscorum supplementum* 1976–1977 (Crosby, 1979).

Passing reference should be made to a special purpose index which provides a means of guiding bryologists to the source of publication of *New combinations and new taxa of mosses proposed by Nils Conrad Kindberg* (Steere and Crum, 1977). It is an annotated alphabetical list supported by an extensive annotated bibliography. Since there are other authors besides Kindberg who have described many taxa (as well as the same one more than once under different names) and who have made many new combinations, e.g. C. Müller for the mosses and F. Stephani for the hepatics, more special purpose lists would be valuable to facilitate rapid access to the appropriate primary sources. Such lists could well be combined with a register of types of the author's taxa. For example, a catalogue of all the types and relevant publications of C. Müller would be invaluable, particularly if the locations of the specimens could be included, since the loss of Müller's herbarium in Berlin-Dahlem during the 1939–45 war has meant that much time is spent hunting for isotypes, etc. Similarly, hepaticology would be well served by a comparable work on Stephani. Such catalogues have been referred to above (p. 87) as single author type registers.

Descriptions of Genera

The *Index nominum genericorum* (Farr, Leussink and Stafleu, 1979) sets out to include, in its three volumes, the names of all validly published generic names for all plant groups, recent and fossil (but excluding bacteria). It represents the culmination of 25 years' work and gives, for each name, the correct citation of the author(s), reference to first valid publication, a record of existing homonymy and the name of the family or major group in which it is placed. The work, first issued as a series of cards, is presented as one consolidated alphabetical list with no separate indices for individual groups and so it becomes a formidable task to get a listing for a single group or family should that be wanted. There are also a number of unfortunate omissions in the hepatic records. Nevertheless, the work is an indispensable reference and a ready means of access to primary sources.

Reference has been made earlier to the need for generic frameworks, preferably in English, of the Musci and the Hepaticae. The most comprehensive world-wide treatments available are very much out of date i.e. the works by Schiffner (1893–95) for Hepaticae, by Paul (1924) and Brotherus (1924–25) for Musci and by Reimers (1954) for the Bryophyta as a whole. Reed and Robinson's (1972) *Index to Die natürlichen Pflan-*

zenfamilien is an invaluable asset to the use of these works since it also facilitates comparisons between the treatments of the Musci in the two editions. In the earlier edition the Musci were by Warnstorf (1901) and Brotherus (1901–09). Thériot (1931) provided a list of corrections to Brotherus' treatment in the second edition. Crosby and Magill's (1977) alphabetical list of moss genera referred to above also indicates the family to which each belongs. The most recent comprehensive listing of the families of hepatics is that by Grolle (1972), but it lacks a listing of genera.

Geographical or systematic basis

The objectives of the *Conspectus of bryological taxonomic literature* were stated in the preface to the first part as follows: "The aim of the *Conspectus*. . . is to provide on a worldwide scale a comprehensive introduction to that part of the literature of taxonomic botany which deals with bryophytes" (Greene and Harrington, 1979). This is to be achieved by the publication in fascicules of the data arranged in two annotated series, Series A (Geographical) and Series B (Systematic).

The geographical series is intended to provide access to literature on a regional basis i.e. by looking up the name of a country or state all references known for that area will be found. Where a current flora, checklist, up to date bibliography or the results of a mapping scheme exists, these are grouped into what is called a *Basic list* and the remainder of the works are given as a *Supplementary list*. Where no such distinction is merited, all the references are given in a single consolidated alphabetical series. What has been published so far relates to Africa and neighbouring islands in the Atlantic and Indian Oceans (Series A (Geographical) Fascicule 1, Greene and Harrington, 1979).

The systematic series is intended to group literature under the names of genera, families and orders provided these have been mentioned in the titles. At the moment no attempt is being made to abstract works with stylized titles such as *Miscellanea hepaticologica*, but they are being incorporated into the basic reference files for later abstraction. At the time of writing (August 1980), the basic alphabetical author index is estimated to contain about 17,000 individual references. An important feature of the systematic arrangement will be the immediate recognition of whether or not a monograph or major regional review exists for a genus. All the more important papers dealing with its species will be included in the list. When these references are extended by the use of those in the bibliographies of the papers cited under each taxon, a comprehensive guide to the most important literature on any genus will be obtained.

Lane (1978) in his work *A geographical guide to the bryophyte floras of the world* set out to "compile a listing of the most recent (through 1976) or, as the case may be, the most useful treatment of the bryophytes for each geographic area of the world. The present geographical guide,

which is modelled after Blake and Atwood, is essentially a bibliography with a geographical index . . . does not conflict with Dr. Greene's broadly conceived conspectus . . . instead it will serve as a quick and convenient introduction." The author provides a single consolidated list of almost 300 briefly annotated references and a geographical index with the name of an author and the date of the one or two works selected for each. According to Lane ". . . the work or works contain a sufficient bibliography to guide the user to additional works for the area involved." The work is admirably presented and has the advantage of covering the whole world. If a criticism has to be levelled it is to echo its authors' doubts about the validity of citing only one reference for each geographic area. If something more along the lines of the small category of works which are included in the *Basic list* for each country in the *Conspectus* had been presented, then the work would have been larger but so much more useful.

One other work with a specialized geographical emphasis should be mentioned here—Sjödin's (1980a) *Index to distribution maps of bryophytes 1887–1975*. The volume available makes reference to nearly 5300 distribution maps by Musci; a volume for the Hepaticae is to appear in the same series before the end of 1980 (Sjödins 1980b). The work consists of an alphabetically arranged list of genera and species based almost entirely on the nomenclature of *Index moscorum* and indicates under each taxon the distribution maps known and their area of coverage. Coverage is world-wide and intended to be comprehensive, starting with the earliest publication to include a distribution map known to the author.

Dates of publication

Determination of publication dates is vexing. This is due to the difference between effective date and bibliographic date and to the importance of effective date.

Reference has already been made to papers by Sayre (1959), Margadant (1968) and Henrey (1975) which are invaluable sources of information for dates of publication of works which appeared at the end of the 18th or the early part of the 19th Century. The use of the effective date by the authors of the *Index muscorum* has also been mentioned.

As a consequence of decisions taken at the 7th International Botanical Congress in Stockholm 1950, 31 December 1801 was selected as the nomenclaturally effective date for Hedwig's (1801) *Species muscorum frondosorum*—the work long regarded as the starting point for the nomenclature of all Musci except *Sphagnum*. This date was chosen because there was a widespread belief among bryologists that it would not be possible to determine with any degree of confidence the month in 1801 when the work appeared (Sayre 1954, 1957). It was decided to choose the arbitrary date of 31 December and treat all other works published in 1801 as "pre-Hedwigian." Not everyone agreed with this decision, and the search for precise information regarding the date of Hedwig's book and

other works of this period led to Sayre's (1959) "*Dates of publications describing Musci, 1801–1821.*" This booklet may fairly be regarded as marking the starting point of the current phase of bryological documentary research since it not only appeared in the same year as the first volume of *Index muscorum* (Van der Wijk, Margadant and Florschütz, 1959–69) but, according to the Introduction to that work (p. xvii), it influenced the choice of 1 January as the starting date for nomenclature of Musci, a decision subsequently ratified at the 9th International Botanical Congress, Montreal in 1959 (Florschütz, 1960). More important, as well as summarizing the state of knowledge at that time, it showed what could be achieved in a field considered "well nigh impossible" by some and indicated a variety of sources for further research which were unknown to the majority of bryologists.

The other most important source of bibliographic data is Stafleu and Cowan's (1976, 1979a) *magnum opus – Taxonomic literature* edition 2, of which 2 volumes (A–G, H–Le) have so far appeared. The work has the informal sub-title "TL-2" by which it is most commonly known. In contrast to Stafleu's earlier work (Stafleu, 1967), which included only a small number of works of interest to the bryologist, the present volumes give a much wider coverage of taxonomic literature. For example, biographical and other data about authors are now provided as well as a detailed analysis of publication dates with supporting evidence where appropriate. Works are considered in chronological order within an alphabetical arrangement of authors. Information is also given on the dates of publication of some journals and periodicals often under the name of their chief editor. An index to names and an index to titles are included. The amount of detailed information provided as well as the scope of the work is impressive and sets high standards for those who aspire to imitate "TL-2." An interim report on the work, its origins and plans for publication has been presented by the authors (Stafleu and Cowan 1979b).

Mention should also be made of *Bibliographia Huntiana*, an ambitious long-term project to compile a bibliography of all botanical literature published between 1730 and 1840. Daniels (1976) reported that, after 15 years work, the BH master file was substantially complete for both books and periodical literature. Information was provided on the proposed plan of publication.

Not many bryologists appear to realize that there is a Society for the Bibliography of Natural History which regularly produces a journal (to be renamed the *Archives of Natural History* from Vol. 10, pt. 1). The present author appears to be the only bryologist to have published in the Society's journal (Greene, 1957a, b, 1958, 1962). Another valuable source of bibliographic information is the paper by van Steenis-Kruseman and Stearn (1954) entitled *Dates of publication* where dates of issue of parts of journals, etc. can often be found.

In spite of the usefulness and coverage of the foregoing works, there

remains a need for much careful documentation research on a variety of bryological publications. Most bryologists find this a frustrating subject since so much time can be wasted looking for information. Of particular value would be a critical assessment of likely sources of bibliographic data on bryological works. Of use would be a list of long-established learned Societies which have well-kept library accession registers with relevant dates and preferably with records stretching back into the late 18th Century. Also of use would be a guide to the correspondence, notebooks and other manuscript materials of botanists. Such material is often well-catalogued, but its existence is known only to a few. Finally we need an account of newspapers, journals and other works such as the *Gentleman's magazine*, *Flora*, Hinrich's *Verzeichnis Neuer Bücher*, or Peddie and Waddington's *English Catalogue*, which included notices and reviews of new publications and which appeared with sufficient regularity to be of value to those seeking information about dates of publication. But in view of the comprehensive nature of the coverage by Stafleu and Cowan in TL-2 (vide list of sources and methods enumerated in the Introduction to Vol. 1 p. ix) such research should be planned to complement that work if time is not to be wasted needlessly retracing ground they have covered so well.

DISCUSSION

Most of the retrieval aids mentioned in this paper have been published over the last 20 years. There is plenty of evidence that their existence has greatly facilitated the work of a large number of bryologists. Other aids are known to be in preparation. For example, W. R. Buck and R. A. Pursell announced recently an *Index iconum muscorum* (Pursell, 1980). The author of the present paper is collaborating with A. J. Harrington in the preparation of an *Index of obituaries and biographies*, a work intended to give rapid access to sources of biographical data and especially bibliographies of bryologists. Obituary notices are virtually the only sources of anything approaching a complete list of their papers.

Other indices not mentioned so far which are used by the taxonomic bryologist give lists of chromosome numbers. The most comprehensive is the *Chromosomenzahlen der Bryophyten eine Übersicht und Diskussion ihres Aussagewertes für das System* by Fritsch (1972). This work is now badly out of date but the author is preparing a new edition (R. Fritsch, personal communication). Moore's (1977) *Index to plant chromosome numbers for 1973/74* brings the list a little more up to date. Steere's (1972) paper includes a valuable bibliography.

At different places in the text, attention has been drawn to "gaps" in the retrieval aids available. Some of these gaps undoubtedly exist because many bryologists prefer to work with plants rather than provide reference

documents. That the author of such a work is not necessarily acknowledged may also act as a deterrent to career conscious scientists and so prevent them from spending time compiling reference works of the sort under discussion. Some bryologists would be perfectly happy for information scientists, librarians, and others working in the fields of documentation and data retrieval to provide the sort of indices they require. If this is to happen, they need to state clearly what they want. While many individuals have clear views about what would be useful, a collective view of priorities has not emerged so far. Another problem which needs thought is how to keep indices updated once the initial work is finished. In the case of *Index muscorum* and *Index hepaticarum,* these indices will be maintained. Perhaps the International Association of Bryologists should also try to ensure the continuity of other works.

There is one other aspect of this subject which needs to be borne in mind. In an inflationary world, publishing costs continue to rise and so, unfortunately, do the costs of the indices and the guides. Many individuals, as well as small and medium-sized libraries, have become very selective in what they purchase and it is only the largest or very specialized libraries which can continue to afford the wide range of literature the taxonomist needs. Hence guides and indices to what is available and which can be sought through inter-library loan schemes etc. are likely to have an increasingly important role to play. The cheaper these works can be produced, ensuring their widest possible availability, the better. There is a good case for trying to get them subsidized to keep down costs. A constraint on the availability of reference works, as well as other literature, already exists in countries operating strict currency controls on the purchase of works produced elsewhere.

In addition to answering the question, "What is required?", bryologists also need to give some thought to the best form of presentation of the data. For example, the same data produced in card form, in fascicule form or as a single thick volume will not only result in different production costs but also in differing sale costs and hence exert an influence on its availability.

Every taxonomist is appreciative of an aid which will save time particularly if, in its absence, he would have to tread again a path already covered by himself or someone else. Is the methodology of past ages retained because there is nothing better available at a reasonable cost to replace it? Or is it perhaps because taxonomists as a body have been slower, or feel less able, than others to demand change? The technology exists to give video display units to every laboratory linked by telephone to a large regional or national biological computer store holding data on the contents of herbaria, libraries, contents of current awareness leaflets, transliterations of titles, abstracts of papers, descriptions of taxa—you name it, you can have it—at a price. The microchip revolution really

will, it seems, bring down the cost of much EDP equipment but it is unlikely to change the data we handle, even if it does in due course alter radically our methodology. Is it too much to hope that bryologists will be ready with ideas of what is required?

To retrieve, yes—but what? That is the question.

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WAS IST *LEJEUNEA SCHUMANNII* CASPARY AUS DEM BALTISCHEN BERNSTEIN?

RICLEF GROLLE*

SUMMARY

Frullania schumannii (Casp.) comb. nov. (≡ *Lejeunea schumannii* Casp. 1887) and *F. scyphoides* Mägdefrau 1957 from Baltic amber (Eocene) are conspecific. A detailed description with photomicrographs, also of the hitherto unknown ♀ involucre, is provided. *Frullania schumannii* probably belongs to the subgen. *Australes* (Verd.) Hatt., of which the recent species are restricted to E. and S. Asia and Australasia.

Lejeunea schumannii Casp. wurde von Caspary (1887) nach "2 Stämmchen in 2 verschiedenen Bernsteinstücken" beschrieben. Wie aus Caspary & Klebs (1906/1907) ersichtlich, befand sich von diesen das bessere Stück, welches 1868 von v. Duisburg gefunden wurde, in der Sammlung des Altstädtischen Gymnasiums zu Königsberg (heute Kaliningrad), während das schlechtere Stück—Nr. 149 der ehemals Künowschen Sammlung—dem Museum für Naturkunde der Humboldt-Universität zu Berlin gehört.

In Caspary (1887) ist nur das Königsberger Stück abgebildet (Tafel I, Bild 10), wie ein Vergleich mit Tafel III, Bild 20 in Caspary & Klebs (1907) erweist. Dieses Stück muß leider als vernichtet gelten, da es in Göttingen (BRD), wohin die einzigen erhaltenen Teile der ehemals Königsberger Bernsteinsammlung gelangten, nach freundlicher Auskunft von Dr. S. Ritzkowsky (Göttingen) nicht vorhanden ist.

Im *Museum für Naturkunde Berlin* blieb hingegen Nr. 149 der ehemals Künowschen Sammlung erhalten und lag mir vor. Caspary & Klebs (1906) bezeichnen Nr. 149 als "schlecht erhalten und jedenfalls recht faulig ins Harz gekommen," was ich nur bestätigen kann. Obwohl Nr. 149 von Caspary (1887) nicht abgebildet wurde, sondern erst von Caspary & Klebs (1907) in Taf. III Bild 21, ist Nr. 149 unzweifelhaft eines der "2 Stämmchen in 2 verschiedenen Bernsteinstücken," die Caspary (1887) erwähnt, und mithin ein Syntypus.

Aufgrund der hervorragenden Übereinstimmung von Bild 20 und 21 in Caspary & Klebs (1907) ist an der Artidentität des vernichteten Königsberger und des erhaltenen Berliner Syntypus nicht zu zweifeln.

Nr. 149—der allein erhaltene Berliner Syntypus—muß daher als Lectotypus (nov.) von *Lejeunea schumannii* Casp. dienen.

Nach Bild 20a in Caspary & Klebs (1907) hat das Königsberger Exemplar eine sehr enge quere Insertion des Blattlobus. Dies ist mit *Lejeunea* Lib. nom. cons. s. str. unvereinbar. Darüber hinaus ist die von Caspary & Klebs (1907) in Bild 20 und 21 wiedergegebene Form des Lobulus für eine *Lejeunea* zumindest höchst ungewöhnlich. Die mikroskopische Unter-

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suchung von Nr. 149 ergibt beim Fokussieren in gutem Auflicht eindeutig, daß die in Bild 21 von Caspary & Klebs (1907) wiedergegebenen Lobuli doppelwandig sind, also Wassersäcke vom *Frullania*-Typ mit basiskoper Öffnung darstellen, was ebenfalls mit *Lejeunea* unvereinbar ist. In meiner Figur 1 habe ich diese Wassersäcke vom *Frullania*-Typ bei Nr. 149 auch fotografisch zu belegen versucht.

Die Wassersäcke vom *Frullania*-Typ und die sehr enge quere Insertion des Blattlobus beweisen, daß Nr. 149 und somit *L. schumannii* Casp. unzweifelhaft zu *Frullania* Raddi gehören.

Caspary's falsche Unterbringung bei *Lejeunea* ließ Mägdefrau (1957) dies Taxon als *Frullania scyphoides* Mägdefrau erneut beschreiben. Mägdefrau's viel besser erhaltene und etwas reichlichere Pflanzen sind insgesamt üppiger, haben eine dichtere Blattkreisfolge und einen im Vergleich zum Lobus größeren Lobulus, was bei rezenten Frullanien sehr variable Merkmale zu sein pflegen. Die vorzügliche allgemeine Übereinstimmung von Nr. 149 der *L. schumannii* Casp. mit dem Holotypus von *F. scyphoides* Mägdefrau in Lobus, Lobulus und Amphigastrien und die Variabilität dieser Organe an den beiden Pflanzen belegen meiner Ansicht nach hinreichend, daß diese lediglich als dürftige und luxuriante Form ein und derselben Art anzusehen sind.

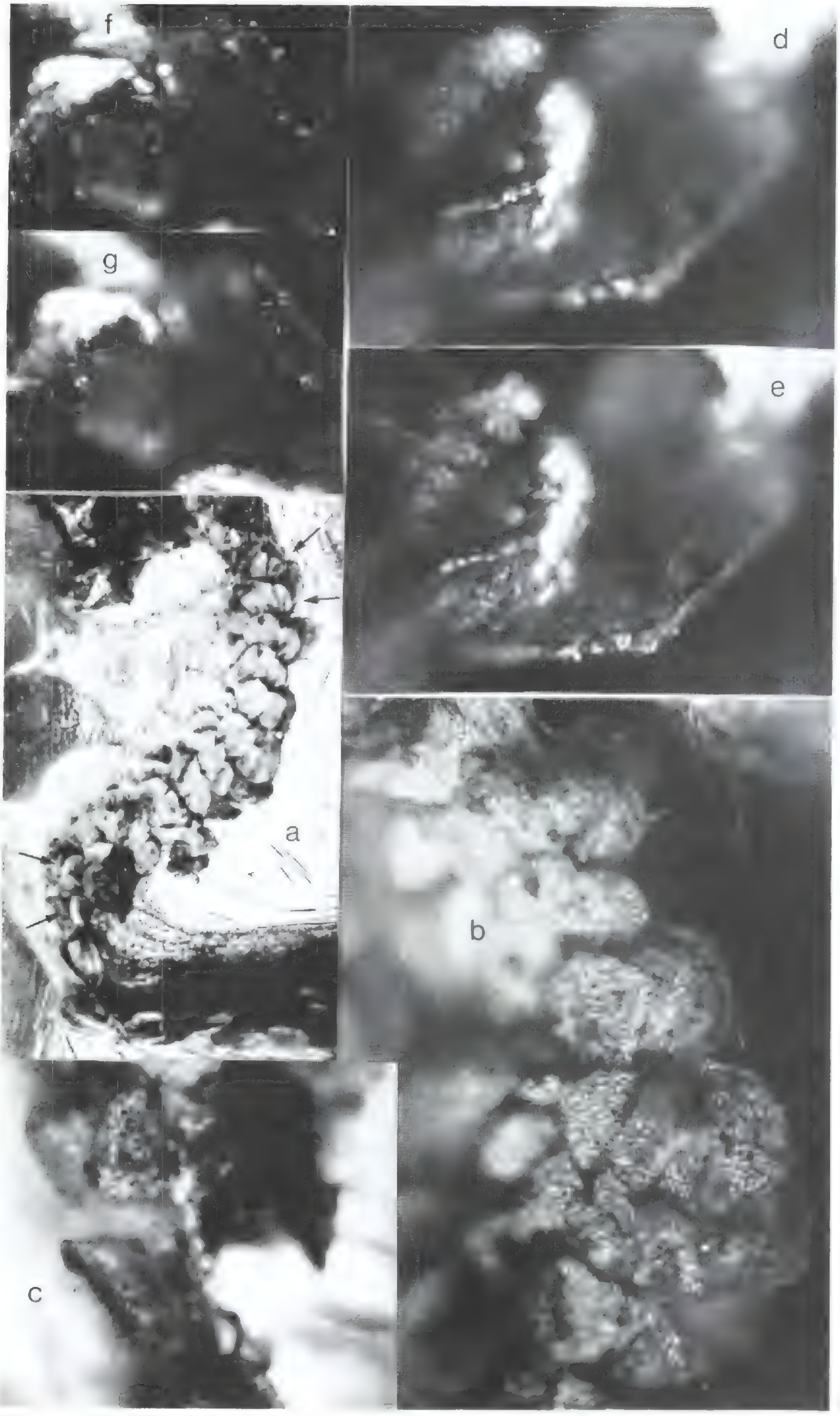
An Hand dieser beiden Exemplare läßt sich das Bild dieser Art erheblich vervollständigen, zumal am Holotypus von *F. scyphoides* auch zwei unbefruchtete Gynözien (und vielleicht 1 Andrözium) zutage kamen, die bisher von dieser Art nicht bekannt waren. Es lohnt daher eine erneute detaillierte Beschreibung:

Frullania schumannii (Casp.) Grolle, comb. nov., Figur 1–5

= *Lejeunea schumannii* Caspary, Schriften Königl. Phys.-Ökon. Ges. Königsberg 27: 3. Taf. I Bild 10. "1886" 1887 ("*Lejeunia schumanni*"). LECTOTYPUS (nov.): Inkluse in baltischem (samländischem) Bernstein (Tertiär: Eozän), Slg. Künow Nr. 149; *Museum für Naturkunde Berlin* (Paläontologisches Museum)! — Hiernach Caspary & Klebs (1907) Taf. III Bild 21 sowie meine Figur 1. — SYNTYPUS (im zweiten Weltkrieg vernichtet): Desgleichen, 1868 leg. v. Duisburg; *Altstädtisches Gymnasium* im ehemaligen Königsberg. — Hiernach Caspary (1887) Taf. I Bild 10 und Caspary & Klebs (1907) Taf. III Bild 20.

= *Frullania scyphoides* Mägdefrau, Berichte Deutsch. Bot. Ges. 70: 434. Taf. XII, Fig. 2–4. 1957; syn. nov. HOLOTYPUS: Inkluse in baltischem Bernstein (Tertiär: Eozän), Slg. Scheele, Bayerische Staatssammlung für Paläontologie und Historische Geologie München (1967 XX 2)! — Hiernach Mägdefrau (1957) Taf. XII, Fig. 2–4 sowie meine Figur 2–4.

FIGUR 1. *Frullania schumannii* (Caspary) Grolle: a. Sproß (Ausschnitt) von ventral (die Pfeile weisen auf Lobuli, die einen Wassersack vom *Frullania*-Typ erkennen lassen), 19×. b. Sproß (Ausschnitt) von ventral, 58×. c. zwei Lobuli (dieselben wie in a bei den beiden untersten Pfeilen), der obere mit erkennbarem dorsalen und ventralen Mündungsrand, der untere in Frontalansicht der Mündung, 70×. d–e. schräg stehender Lobulus (derselbe wie in a beim zweitobersten Pfeil) mit teilweise erkennbarem Mündungsrand (in zwei optischen Ebenen), 175×. f–g. Lobulus (derselbe wie in a beim obersten Pfeil) mit fast frontaler Ansicht der Mündung (in zwei optischen Ebenen), 175×. — Alle nach Nr. 149, dem Lectotypus von *Lejeunea schumannii* Caspary.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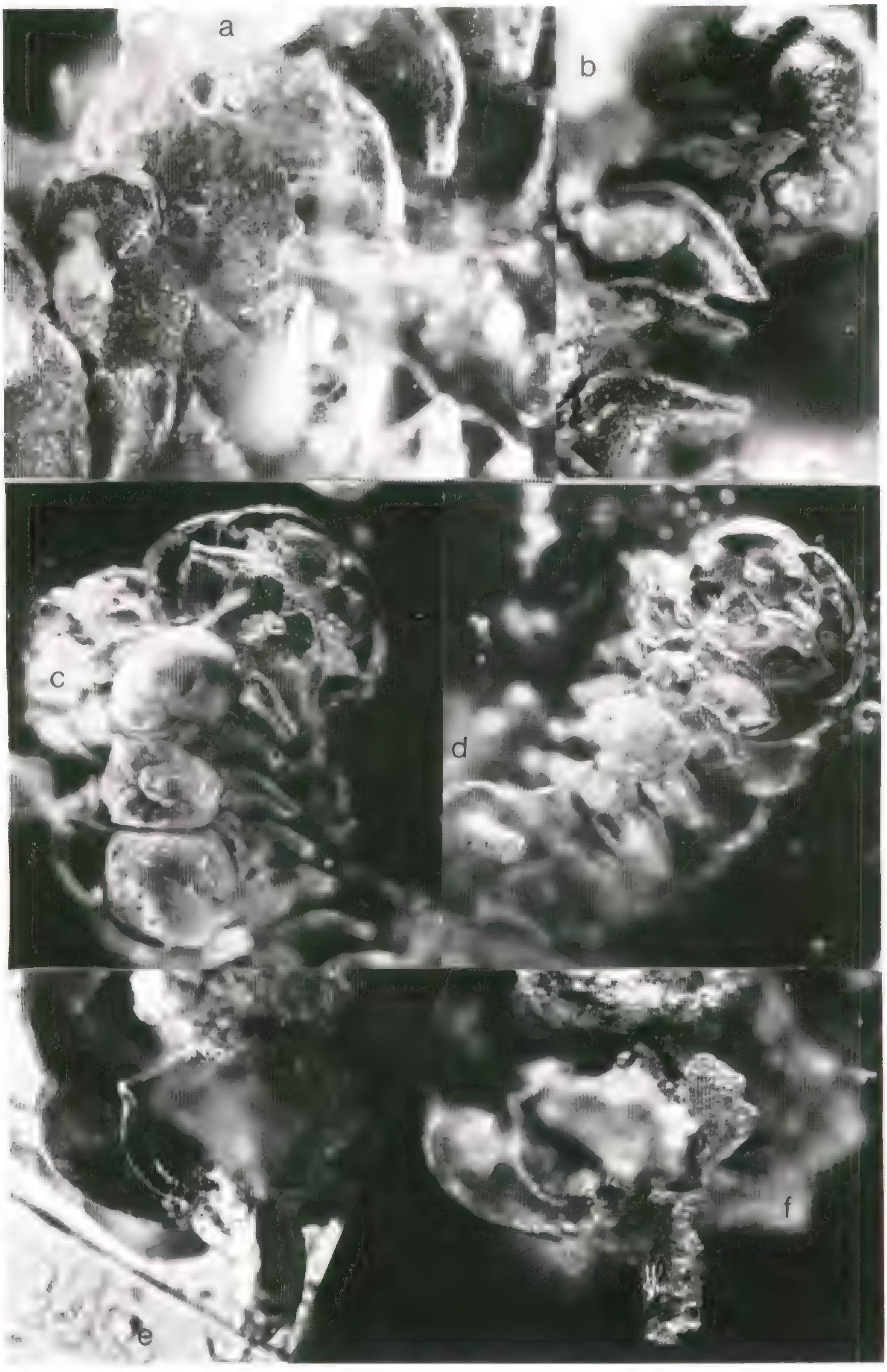
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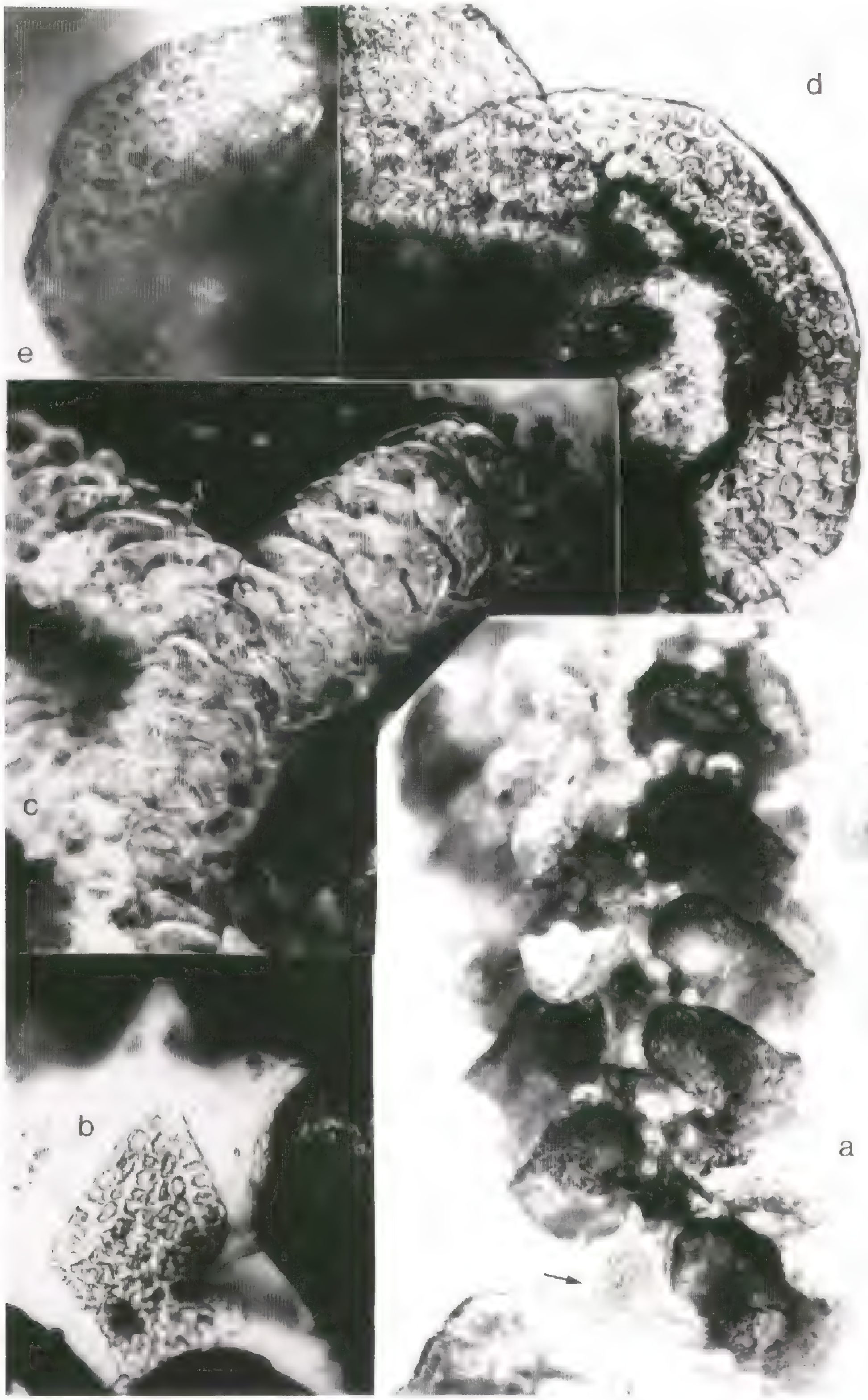
Wahrscheinlich autözisch (nur ♀ sicher bekannt), bräunlich bis kupferbraun, bis 2 cm lang, mit 0.7–0.85 mm breiten Sprossen, reich verzweigt, sehr unregelmäßig fiederig, Verzweigung vermutlich vom *Frullania*-Typ (Astbasis stets verdeckt), Äste fast rechtwinklig von der Hauptachse abstehend, dieser gleichend. — *Stengel* 120 μm dick, Rinde aus schmal rektangulären Zellen mit kräftiger Wandverdickung. *Rhizoide* sehr zahlreich, als kurzes Büschel oder Bündel nur wenig unterhalb der Amphigastriummitte aus der Amphigastriumlamina entspringend. — *Blätter* sehr eng quer inseriert, gemäßigt bis sehr dicht stehend, den Stengel von dorsal völlig verdeckend, diejenigen einer Sproßseite sich dachziegelig oberschlächtig überdeckend, mit denen der anderen Sproßseite durch Vorragen der dorsalen Lobusseite bis ± weit über den Stengelrand dorsal tief verschränkt. *Lobus* völlig flach, nahezu kreisrund, an schwächeren Sprossen ± elliptisch, 0.45–0.52 × 0.45–0.52(0.6) mm, apikal stets halbkreisförmig rund,[1] ventraler Seitenrand nur schwach gebogen, dorsaler gleichmäßig stark gebogen, rings völlig ganzrandig. *Zellen* überall gleich hexagonal isodiametrisch, 15–23 × 15–23 μm, mit schwacher Wandverdickung, ohne oder mit ± deutlichen, allmählich anschwellenden Eckverdickungen. Kutikula glatt. Ozellen fehlen. *Kiel* kurz. *Lobulus* stets als Wassersack ausgebildet, dieser kappenförmig oder oft — besonders an Ästen — etwas glockenförmig, den Lobus meist größtenteils überdeckend, sehr groß, (0.25)0.3–0.36 mm lang, an der Mündung 0.2–0.3 mm breit und oft schwach rostrat, den nächsten Wassersack teilweise überdeckend, im Winkel von 10°–25° *zum* Stengel hin gerichtet (nur an schwächeren Sprossen oft annähernd stengelparallel) und diesen mit dem Apikalteil oft bis zur Stengelmitte (zuweilen auch etwas darüber) von ventral überlagernd, die Lobuli der beiden Sproßseiten also zusammenneigend, ihre Scheitel median zusammentreffend oder sich sogar gegenseitig etwas überlagernd, basale Hälfte der Wassersäcke konkav (von ventral gesehen), apikale Hälfte konvex (von ventral gesehen), von dieser entlang der distalen Seite ein rüsselförmiger Schlauch zum distalen Mündungsende führend und dieses sogar manchmal als kurzer

[1] Mägdefrau (1957) gibt an "zum Teil mit schwacher Spitze". Dies kann ich nicht bestätigen. Vielmehr fand ich nur als Artefakt gelegentlich eine schwache Zuspitzung. Sie wird vorgetäuscht von einer weißen Umrahmung, die bei verschiedenen Organen von Mägdefrau's Pflanze auftritt.

FIGUR 2. *Frullania schumannii* (Caspary) Grolle: a. Amphigastrien am Hauptsproß (rechts unten zweigt ein Ast ab, von dem jedoch nur ein kleiner Teil auf dem Bild ist), 70 ×. b. rechts oben 1 Lobulus in Seitenansicht, links unten 3 Lobuli in schräger Sicht, 70 ×. c. Ventralansicht eines Astgipfels, an dem vor allem 1 Amphigastrium gut sichtbar ist (basalwärts davon 3 große Fremdstoff-Ballen), 35 ×. d. Ventralansicht eines anderen Astgipfels mit einigen gut sichtbaren Lobuli und Lobi, 35 ×. e. abgebrochener Sproß, an dem der Stengel, der ganze Ventralrand des Lobus, nahezu der gesamte Mündungsrand des Lobulus und der Amphigastriumrand bis zur Basis sichtbar sind, 70 ×. f. dasselbe mit scharf abgebildeten oberen Teil des Amphigastriums, 70 ×. — Alle nach dem Holotypus von *Frullania scyphoides* Mägdefrau.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gestutzter Schnabel etwas überragend (rostrat), ventraler Mündungsrand gerade quer gestutzt oder schwach gebogen, dorsaler Mündungsrand etwas mehr basiskop und stärker bogig. Stylus nicht sichtbar. — *Amphigastrien* mit enger Basis ziemlich gerade quer inseriert und nicht herablaufend, 2.5–3 × so breit wie der Stengel, so breit wie lang oder etwas breiter als lang (etwa in der Mitte am breitesten), 0.28–0.36 × 0.3 mm, die Proximalseite der Wassersäcke überdeckend, ± rhombisch, mit keilförmiger Basis, apikal zu ¼–⅓ zweilappig, Bucht spitz- bis rechtwinklig mit gewinkeltem bis abgerundetem Grund, Lappen apikal schräg breit gestutzt, dreieckig, meist etwas breiter als lang, am Gipfel oft abgerundet, Seitenränder beiderseits in der oberen Hälfte mit 1–2 größeren Buckeln, seltener Zähnen, sonst ganzrandig. Zellen ähnlich denen des Blattlobus, aber kleiner. — *Andrözien* (nur 1 × nicht ganz sicher bei der Münchner Pflanze) eiförmig, an sehr kurzem Seitenast, in autözischer Stellung. — *Gynözien* (nur unbefruchtet 2 × an der Münchner Pflanze bekannt) terminal am Hauptsproß, pseudolateral durch einen innovierenden Seitenast, subinvolukral nur 1(2) Blattkreise schwach vergrößert. *Involukralblätter* bis weit über die Mitte zweilappig, Lobus nur beschädigt bekannt, ganzrandig. *Kiel* kurz, verborgen. *Lobulus* recht groß, nur wenig kürzer als der Lobus, ganzrandig, lanzettlich, abgerundet zugespitzt, rinnig konkav (von ventral gesehen). *Involukralamphigastrium* fast so lang wie der involukrale Lobulus, in der Längsmediane etwas zusammengezogen, Lappen ganzrandig, lanzettlich, apikal eng abgerundet zugespitzt, etwas rinnig konkav (von ventral gesehen). — Alles Übrige nicht bekannt.

Am Lobusrand vieler Blätter und besonders der Involukralblätter des Holotypus von *Frullania scyphoides* ist eine weißliche Umrahmung von manchmal enormer Breite vorhanden. Auch an der Distalseite der Wassersäcke und vereinzelt sogar an Amphigastriumrändern kommen solche weißliche Umrahmungen vor, wenn auch schmaler. Diese vorgetäuschten Säume sind stets außerhalb der Pflanze und durch nadelförmige Kristalle fein querstreifig. Eine überzeugende Erklärung der Entstehung dieser Artefakte vermag ich nicht zu liefern.

Mit Ausnahme arktischer Gebiete ist die Gattung *Frullania* weltweit verbreitet. Von den 400–500 rezenten Arten sind die meisten tropisch und subtropisch.

Bei Zugrundelegung der *Frullania*-Gliederung von Hattori (1976) wäre eine Unterbringung von *F. schumannii* im Subgen. *Trachycolea* Spruce

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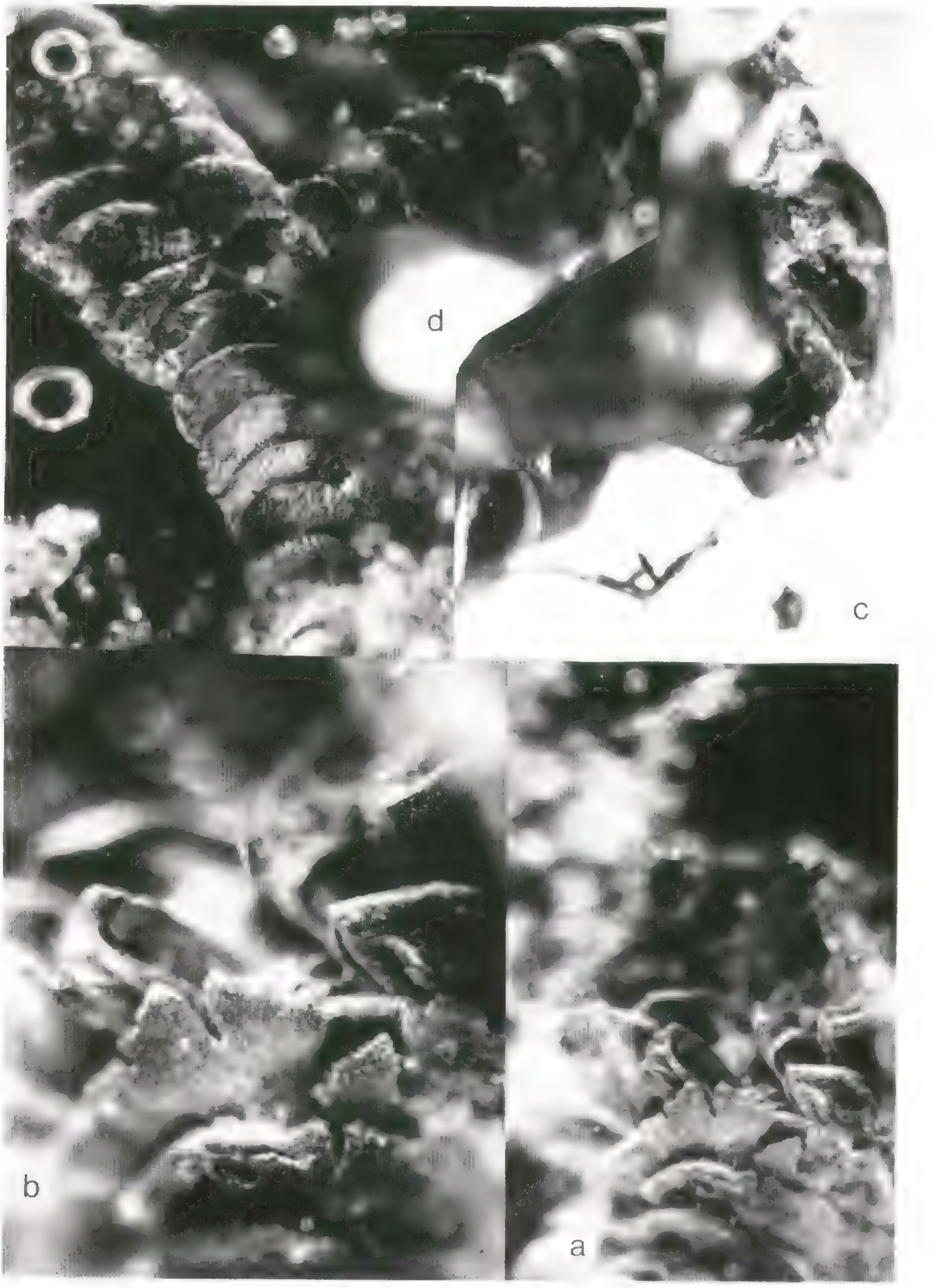
FIGUR 3. *Frullania schumannii* (Caspary) Grolle: a. basal abgerissener Ast mit relativ gut sichtbaren Lobuli, 70 ×. b. abgerissener rechter Teil (derselbe wie beim Pfeil in a) eines Amphigastriums mit gut sichtbarem Zellnetz, 175 ×. c. verzweigter Sproßteil von ventral, 27 ×. d. Zellnetz im oberen Teil des Lobus (Eckverdickungen sehr schwach oder fehlend), 175 ×. e. desgleichen (Eckverdickungen deutlich), 175 ×. — Alle nach dem Holotypus von *Frullania scyphoides* Mägdefrau.

oder im Subgen. *Australes* (Verd.) Hatt. denkbar. Für eine *Trachycolea*-Zugehörigkeit sprechen die nur wenig länger als breite Form des Wassersacks mit rüsselförmigem Schlauch an der Distalseite und der kurze gestutzte Schnabel des Wassersacks. Für eine *Australes*-Zugehörigkeit



FIGUR 4. *Frullania schumannii* (Caspary) Grolle: a. Gynözium von ventral, 35 ×. b. dasselbe, 70 ×. c. Andrözium (?) von ventral, 70 ×. d. Sproß von dorsal, 35 ×. —Alle nach dem Holotypus von *Frullania scyphoides* Mägdefrau.

FIGUR 5. *Frullania schumannii* (Caspary) Grolle: a. unbefruchtetes Gynözium von ventral, 41 ×. b. Androzium (?) von ventral, 41 ×. Gestrichelt sind die Ränder der weißlichen Umrahmung, durchgezogen die Ränder der Pflanze gezeichnet. – Alle nach dem Holotypus von *Frullania scyphoides* Mägdefrau.

sprechen die etwas glockenförmige Gestalt des Wassersacks (besonders an Ästen), seine *zum* Stengel gerichtete Stellung mit Überlagerung des Stengels und das Zellnetz des Blattlobus. Dr. S. Hattori (Nichinan, Japan) äußerte *in lit.* aufgrund von Fotos, die ich ihm sandte: "...this fossil *Frullania* may probably [be] included in the modern subgen. *Australes.*"

Das Subgen. *Australes* ist rezent nur aus O- und S-Asien (*Frullania inflexa* Mitt.: Japan-Himalaja, *F. campanulata* Sde.-Lac.: Indonesien, *F. mizutanii* Kamim. & Hatt.: Borneo, *F. errans* Verd.: Neuguinea, *F. balaoina* Gott. ex Steph.: Neukaledonien) sowie mit einer Reihe Arten aus Australasien bekannt.

Unter Europas 13 rezenten *Frullania*-Arten ist hingegen keine mit *F. schumannii* näher verwandt.

Für die Ausleihe der erforderlichen Originalstücke möchte ich Prof. Dr. R. Daber (Berlin) und Prof. Dr. D. Herm (München) bestens danken, ebenso Prof. Dr. K. Mägdefrau (Deisenhofen bei München) für seinen Hinweis auf den jetzigen Aufbewahrungsort des Originals von *Frullania scyphoides* Mägdefrau. Dr. S. Hattori (Nichinan, Japan) gebührt Dank, daß er sein Urteil über die taxonomische Verwandtschaft von *F. schumannii*, gestützt auf seine unvergleichlichen Erfahrungen mit *Frullania*, beisteuerte. Dr. A. Leman (Jena) danke ich für freundschaftliche technische Hilfe. Herrn G. Schörlitz (Jena) gilt mein herzlicher Dank für die ausdauernde Mühe, die er den Mikrofotos widmete.

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RICCIA D'AMERIQUE TROPICALE

S. JOVET-AST*

SUMMARY

Seven species of *Riccia* collected in Costa Rica in 1979 and six species from the Botanical Garden of Mexico in 1966 and 1979 are reported. Of the Costa Rican collections four are known from Tropical America and three are widely distributed throughout the world. Of the Mexican material *R. dorsiverrucosa* Hässel is the most interesting since previously it had never been found with spores. The spores are described and illustrated.

Récoltes de *Riccia:* 1) au Costa Rica, en 1979, 7 espèces dont 4 connues en Amérique tropicale et 3 plus largement réparties dans le monde. 2) au Jardin Botanique de México, en 1966 et en 1979, 6 espèces dont *Riccia dorsiverrucosa* Hässel connu jusqu'alors à l'état stérile (description et photographies des spores).

I — RICCIA DU COSTA RICA

En août 1979, en compagnie de Leda Meléndez-Howell, j'ai récolté au Costa Rica, pays très peu exploré par les Bryologues, 16 spécimens de *Riccia* appartenant à 6 espèces. En septembre 1979, Leda Meléndez-Howell, seule, a trouvé 6 exemplaires (indiqués ci-dessous "L.M.-H.") représentant 3 espèces dont une n'avait pas été collectée en août.

Voici donc la liste des 7 espèces de *Riccia* et des localités de récolte.

1. *Riccia stenophylla* Spruce

— San José, dans la ville, alt. 1200 m.
Sur la terre fraîche, dans la cour de l'ITCO, 22.8.79.
Sur la terre très humide, Jardin du Musée d'Histoire Naturelle, 24.8.79.
Sur la terre, au bord des tombes, cimetière central, 15.8.79.
Sur un talus terreux, à la sortie de San José, 12.8.79.

— Paso Ancho, près de San José, sur la terre, sous les caféiers, alt. 1200 m. Leg. L.M.-H., 9.9.79.

— Près de Alajuela, au bord d'une route, sur un talus de terre, au-dessus du caniveau, avec *Anthoceros* sp., 11.8.79.

— Turrialba, station IICA, sur le sol dégagé, à la limite de la forêt, 13.8.79.

— El Rodeo, sur terre rouge humide et ombragée, dans une allée, près de la maison, 26.8.79. Récolté à l'état stérile. Des anthéridies très saillantes, dans une profonde dépression médiane du thalle se sont formées en culture. Les spores, obtenues en très bon état, ont mûri dans des cultures de 2 mois ½ (voir photos des spores de *R. stenophylla* in S. Jovet-Ast, 1978). Sur l'apex de thalles jeunes, j'ai compté n = 8, soit 2J + 4V + 1 long droit + 1 très court mais non ponctiforme.

Près de El Rodeo, paroi fraîche et ombragée au bord d'un rio très violent, avec *Targionia, Anthoceros, Cyathodium.*

— Santa Ana. Leg. L.M.-H., 8.9.1979.

— Tres Ríos, 1600 m alt. Leg. L.M.-H. — Sans spores, détermination probable.

DISTRIBUTION: Paraguay, Uruguay, Argentine, Brésil, Costa Rica.

2. *Riccia membranacea* Gottsche et Ldbg.

— San José, Barrio México, talus terreux et sableux, un peu humide, 1200 m alt., 14.8.1979.

— Paso Ancho, près de San José, sur la terre, sous les caféiers, 1200 m alt. Leg. L.M.-H., 9.9.1979.

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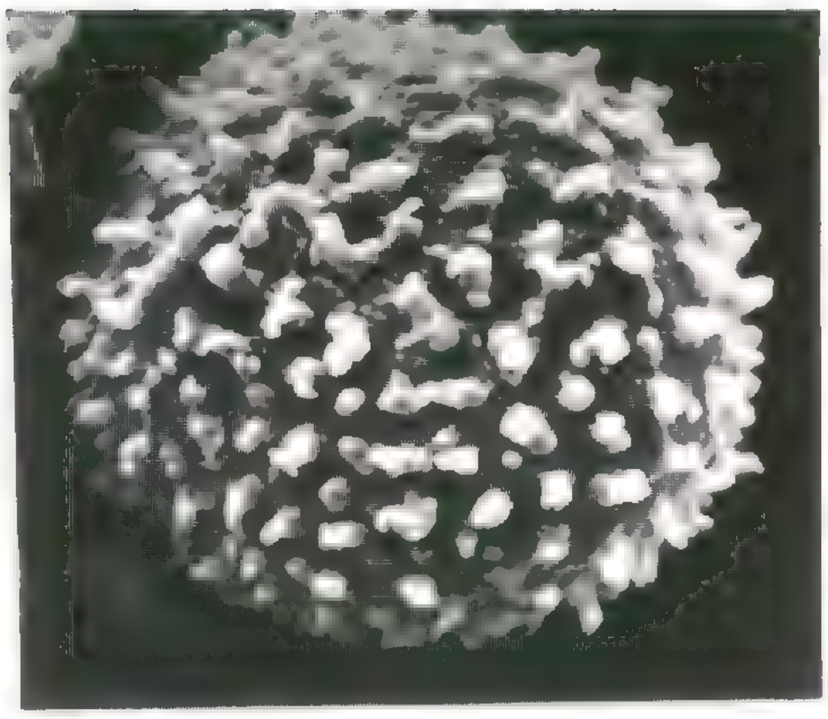

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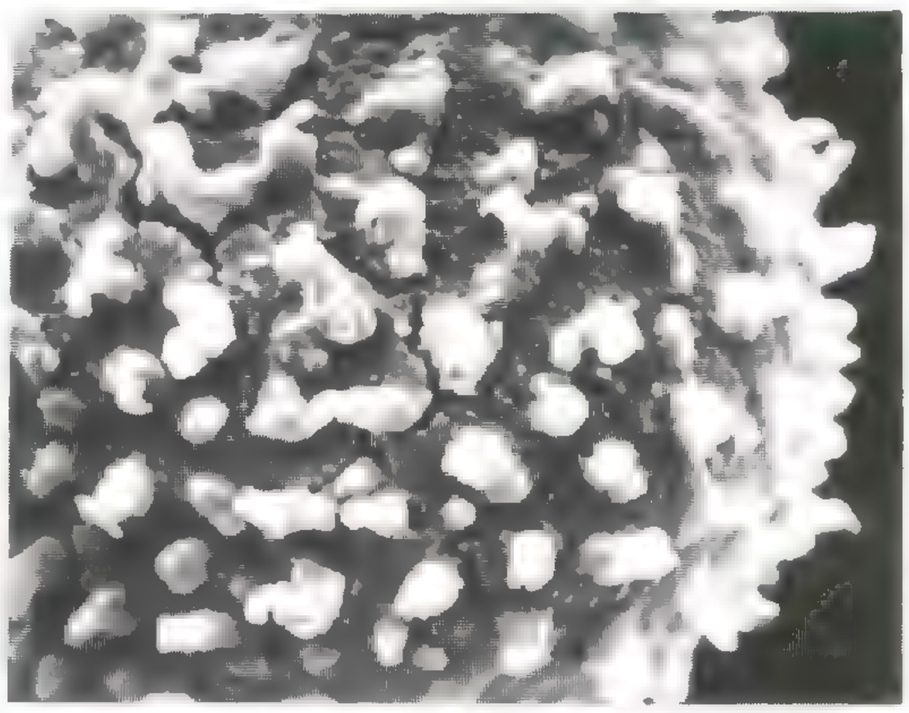

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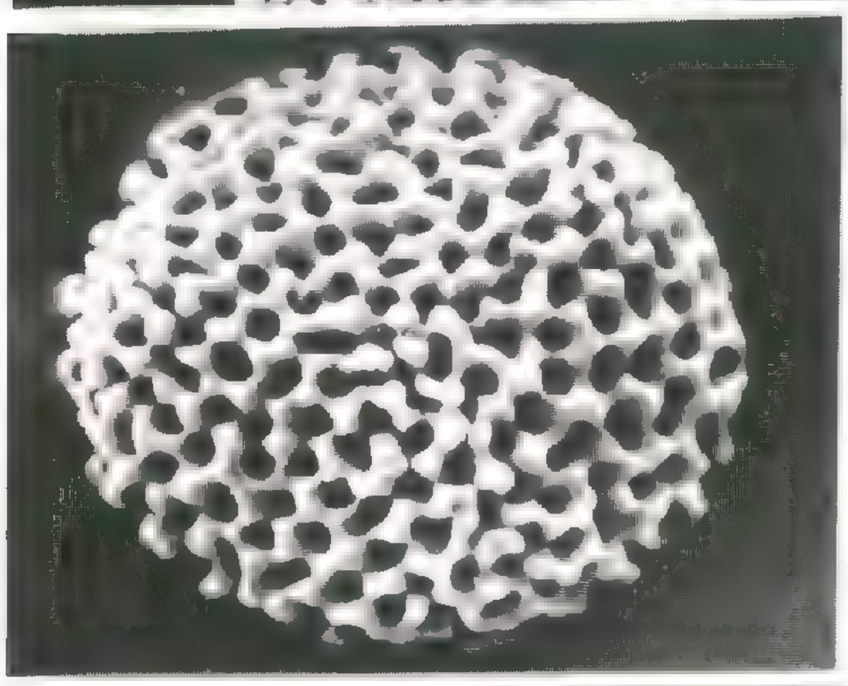

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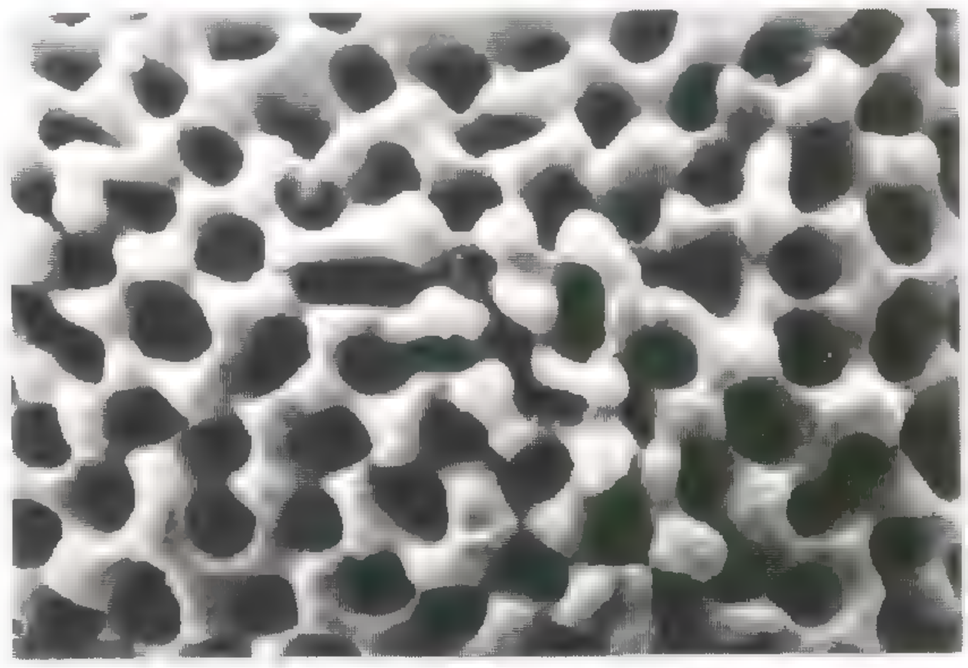

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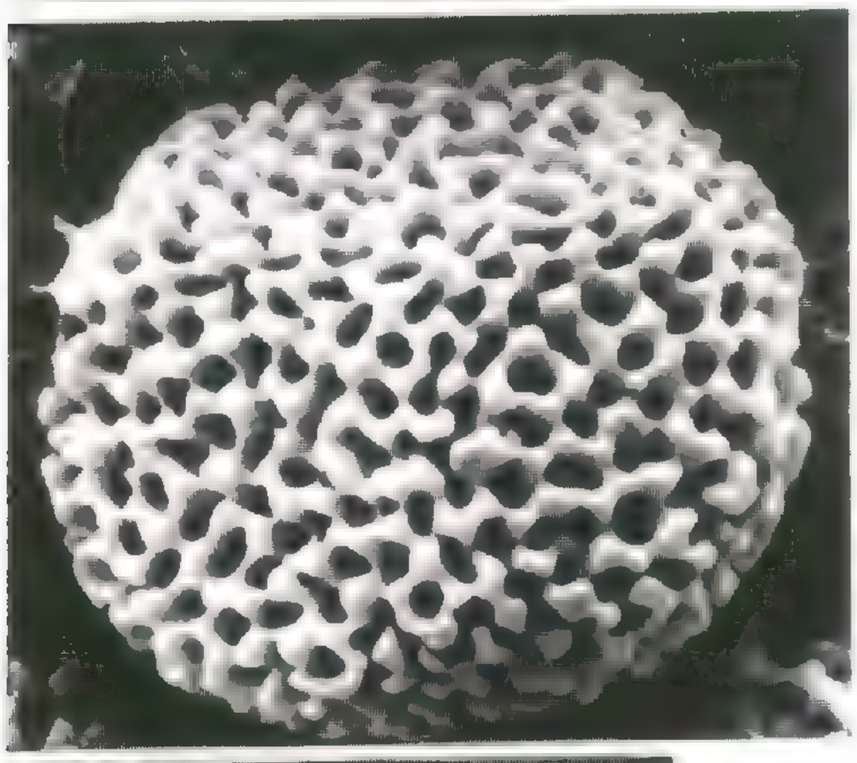

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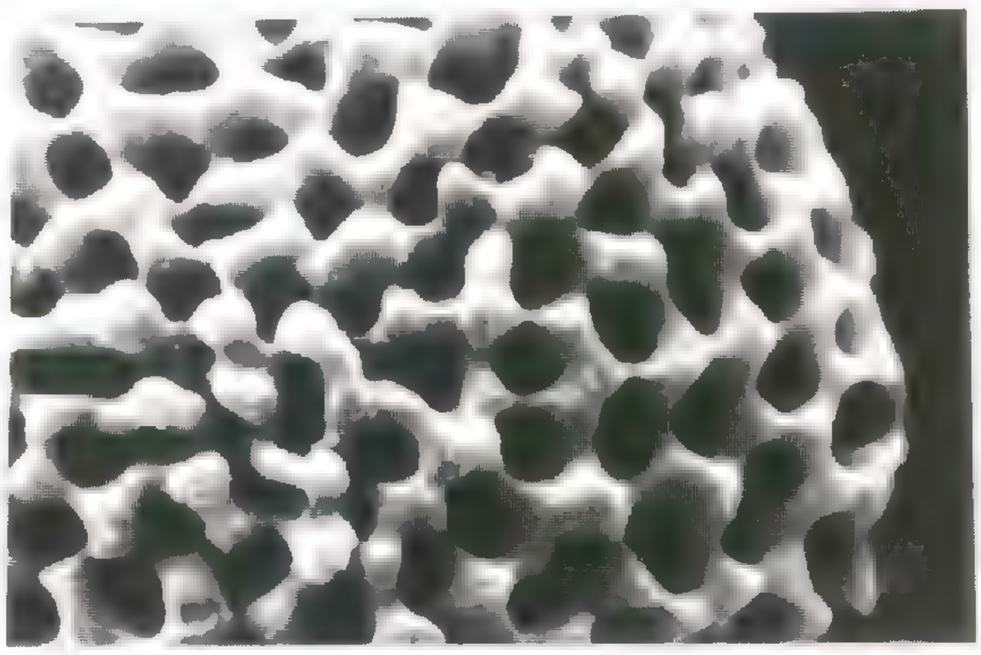

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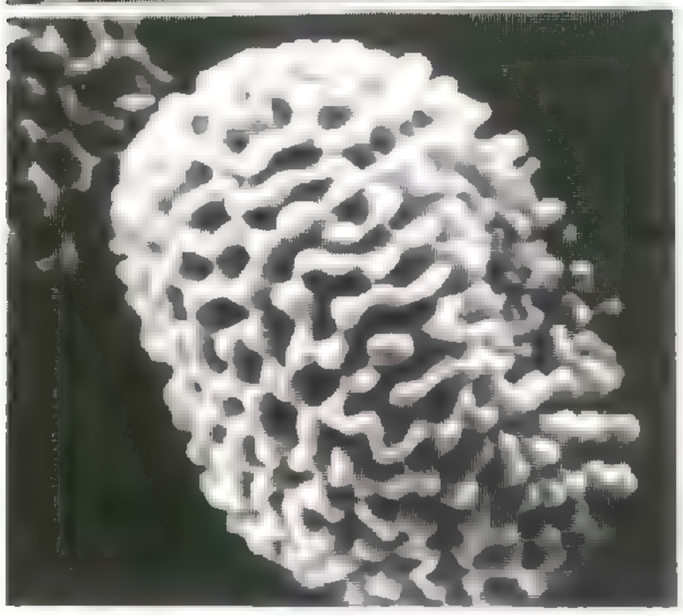

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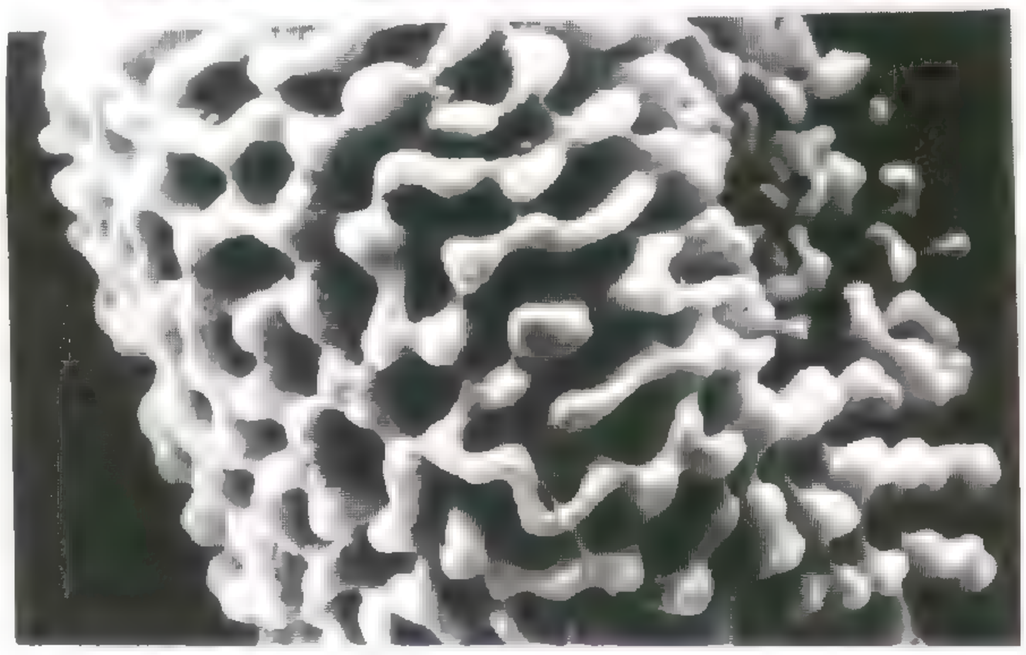

10

—San Pedro de Montes de Oca, sur la terre d'un pot de fleurs, 1200 m alt. Leg. L.M.-H., 10.9.1979. Spécimen portant des spores ornées de tubercules nombreux souvent arrondis au sommet, parfois tronqués ou aigus ou rarement bifides, Pl. I fig. 1, 2, 3.

DISTRIBUTION: États-Unis, Amérique Centrale, Amérique du Sud, Afrique.

3. *Riccia Curtisii* (Aust.) St.

—Granadilla, nord de Montes de Oca, sous les caféiers et bananiers, 1400 m alt. Leg. L.M.-H., 10.9.79.

DISTRIBUTION: Amérique, Afrique, Asie.

4. *Riccia bialbistrata* Hässel

—San José, cimetière central, sur la terre des allées, au bord des tombes, 1200 m alt., 15.8.1979.
—A la sortie de San José, sur talus terreux avec *R. stenophylla*, 1200 m alt., 12.8.1979.

Noter sur ces deux échantillons: ponctuation fine sur la moitié supérieure des cils du thalle; diamètre des spores, 90–108 μm; 9–11 alvéoles dans le diamètre des spores.

DISTRIBUTION: Argentine, Costa Rica.

5. *Riccia plano-biconvexa* St.

—Turrialba, 600 m alt., Station IICA, 13.8.1979.
—Vers Alajuela, paroi subverticale terreuse, ombragée par de grands arbres, 1000 m alt., 11.8.1979.
—Liberia, sur la terre nue et humide d'un jardinet, 21.8.1979.

DISTRIBUTION: Paraguay, Brésil, Argentine, Costa Rica.

6. *Riccia sorocarpa* Bisch.

—Taras de Cartago (route de San José à Turrialba), bord d'un rio, sur vase sableuse humide, 1500 m alt., 13.8.1979.

DISTRIBUTION: tous les continents.

7. *Riccia Wainionis* St.

—Parc naturel de Santa Rosa, près de "La Casona", sur petit talus terreux, 21.8.1979. Sur ce spécimen, on note, comme chez les échantillons antillais, la présence de bandes épaissies longitudinales disposées par deux sur chaque face des cellules du tissu chlorophyllien (Jovet-Ast, 1957).

DISTRIBUTION: Antilles, Brésil, Costa Rica, Paraguay, Argentine, Curaçáo.

PLANCHE I. —1–3: *Riccia membranacea* Gottsche et Lindb. (Costa Rica, San Pedro de Montes de Oca), spores et détail de l'ornementation de la paroi sporale. —4–10: *R. dorsiverrucosa* Hässel (México, leg. Düll, A 72). 4: spores (anisosporie). 5: spore, face distale. 6: spore, face proximale. 7: spore de profil (équateur). 8: détail du centre de la face distale. 9: détail de la face distale montrant l'absence d'aile. 10: ornementation de la paroi, à l'équateur; par suite de la dessiccation, le centre de la face distale (à droite) est concave. Photographies, S. J.-A. au microscope à balayage. —Echelle: fig. 3, 8, 9, 10 = 20 μm; fig. 2 = 30 μm; fig. 5, 6, 7 = 40 μm; fig. 1, 4 = 80 μm.

II — RICCIA DU JARDIN BOTANIQUE DE MÉXICO

Il est bien connu que les allées des jardins, et surtout celles des jardins botaniques, sont des stations particulièrement riches en Marchantiales. notamment dans les régions jouissant d'un climat chaud et d'une saison pluvieuse.

Au jardin botanique de México, sur les allées, à la base des blocs de lave, sur les placettes nues entre les touffes de fougères ou de plantes à fleurs, la terre noire, très finement grenue, résultant de l'écrasement de la lave, tassée par le piétinement, constitue un support très favorable à l'installation des *Oxymitra* et des *Riccia*.

En 1966, R. Düll y fit quelques récoltes qu'il m'envoya, en 1979, pour détermination.

En août 1979, je prélevai également quelques spécimens dans ces grandes taches constituées de milliers de thalles serrés les uns contre les autres.

L'intérêt de ces récoltes — sans doute très incomplètes — n'étant pas négligeable, je donne ici la liste des espèces rapportées par R. Düll et par moi-même. Les spécimens sont conservés soit à Duisburg, soit à Paris (PC).

1. *Riccia dorsiverrucosa* Hässel

— A 72, Fl. México. Botanischer Garten, México City, Freigelände, Lavageröll, c. 2300 m.s.m. Leg. R.D., 27.8.1966. c. sp.
— Allée du Jardin Botanique, México. Leg. S. J.-A., 30.8.1979. c. sp.

En 1962, G. Hässel de Menendez décrivit d'Argentine *R. dorsiverrucosa*, espèce caractérisée par les épaississements des parois cellulaires des deux assises supérieures dorsales et la présence de granules circulaires ou elliptiques, séparés les uns des autres, au nombre de 8 par diamètre, localisés sur la paroi basale des cellules de l'assise externe dorsale. Les spécimens récoltés dans 4 localités de deux provinces d'Argentine étaient stériles donc les caractères sporaux restaient inconnus.

Les deux récoltes du Jardin Botanique de México présentent tous les caractères du thalle décrits par G. Hässel de Menendez. Toutes deux possèdent des spores sphériques, dépourvues d'ailes, apparemment de deux tailles, les unes petites, de 67–76 μm de diamètre, les autres plus grosses, atteignant 84–96 μm; à bord crénelé par la saillie des tubercules; ornées, sur la face distale, de 10–14 alvéoles par diamètre, ces alvéoles formant un réseau très fin mais portant des tubercules brun rouge ou noirâtres et très saillants, parfois confluents; à face proximale entièrement alvéolée mais formant un réseau plus clair et un peu moins saillant de murets larges et bas, passant progressivement à l'ornementation de la face distale; à marque triradiée faible ou presque absente, distincte seulement en raison de la présence des facettes de la face proximale. Pl. I, 4–10.

Sur le spécimen "Jovet, 1979", j'ai pu compter 8 chromosomes dans les cellules de l'apex du thalle.

2. *Riccia mauryana* St.

—A 75, Fl. México. Botanischer Garten, México City, Freigelände, Lavageröll, c. 2300 m.s.m. Leg. R.D., 27.8.1966.

Espèce rappelant *R. dorsiverrucosa* Hässel et *R. Elliottii* St. par la présence de verrues sur la face inférieure des cellules épidermiques dorsales mais dont la section du thalle est 2 fois ½ plus large que haute et atteint 2,2 mm de largeur. Ce spécimen est dépourvu de spores mais le thalle ressemble à celui du type de *R. mauryana* St. décrit du Cerro de Guadalupe, au Mexique.

3. *Riccia nigrella* DC.

—Dans les allées du jardin, sur terre noire. Leg. S. J.-A., 30.8.1979. c. sp.

4. *Riccia sorocarpa* Bisch.

—A 74, Fl. México. Botanischer Garten, México City, Freigelände, Lavageröll, c. 2300 m.s.m. Leg. R.D., 27.8.1966.
—Allées du Jardin, sur terre noire. Leg. S.J.-A., 30.8.1979. c. sp.

5. *Riccia trichocarpa* Howe

—A 73, Fl. México. Botanischer Garten, México City. Freigelände. Lavageröll, c. 2300 m.s.m. Leg. R.D., 27.8.1966.

Les spores de ce spécimen semblent relativement petites (72–84 μm de diam), possèdent 15–20 alvéoles dans le diamètre sur la face distale.

6. *Riccia cf Wainionis* St.

—A 73, mêlé à *R. trichocarpa*.

Le thalle, âgé et en mauvais état, se brise facilement. Sa structure reste donc mal connue. Les spores de 80–96 μm de diamètre présentent, sur la face distale, 6–8 alvéoles à murets épais et forts tubercules aux angles des murets; sur la face proximale, des alvéoles moins régulières mais bien indiquées et une marque triradiée peu visible. Il ne s'agit donc pas de *R. plano-biconvexa* St. auquel on aurait pu le rapporter étant donné l'aspect extérieur du thalle mais, très probablement, de *R. Wainionis*.

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FERDINAND FRANÇOIS GABRIEL RENAULD (1837–1910) SA VIE – SES CORRESPONDANTS

Denis Lamy*

SUMMARY

Some events of the life of the bryologist Ferdinand Renauld (1837–1910) are reviewed. He published two important works: "Prodrome de la flore bryologique de Madagascar. . ." in 1896 and, "Essai sur les *Leucoloma*. . ." in 1906. The role of some of the officials of the Principauté de Monaco in these publications is also reviewed. PC purchased his herbarium in 1909. An inventory of F. Renauld's correspondence, kept at PC, shows 826 letters from 119 bryologists. botanists, and friends. Some extracts from letters written by N. Boulay, E. Bescherelle, E. Delamare, I. Franc, in addition to some information on their lives, provide a better knowledge of these four botanists.

En 1910, I. Thériot publia une notice biographique et bibliographique très complète et très juste de son ami F. Renauld. L'inventaire et l'exploitation des lettres reçues par F. Renauld entre 1870 et 1907 m'ont amené à fouiller plus profondément dans sa vie et à déterminer qui étaient certains de ses correspondants. Cette note est donc à considérer comme un complément d'information permettant de mieux cerner la personnalité de Renauld et celle de quelques uns de ses contemporains.

Ferdinand François Gabriel Renauld naquit à Vesoul (Haute-Saône), le samedi 18 novembre 1837, de Ferdinand Augustin Renauld, propriétaire, 39 ans, et de Marie Louise Joséphine Chambard, 16 ans. Après des études au collège de Vesoul, puis au lycée de Dijon, il s'engagea dans les spahis le 27 décembre 1856. Il fit sa carrière dans différents régiments de cavalerie, effectuant 8 campagnes en Algérie, de janvier 1857 à décembre 1857 et de janvier 1860 à septembre 1863. Durant ces campagnes, il contracta une intoxication "miasmatique." Celle-ci entraîna une gastralgie, se traduisant par des difficultés de digestion et un amaigrissement significatif. F. Renauld fut donc obligé de prendre deux congés temporaires entre octobre 1869 et septembre 1870, et entre octobre 1870 et mai 1874. Nommé capitaine le 27 octobre 1879, F. Renauld était très apprécié de ses supérieurs, comme l'atteste ce rapport du 12 août 1883: "Plus on connaît le Capitaine Renauld, plus on apprécie sa dignité, l'excellence de ses principes, son honorabilité, la loyauté de son caractère, son initiative et son aptitude remarquable. Pourquoi sa santé altérée par un séjour de plus de 5 années en Algérie, l'a-t-elle obligé à se tenir longtemps éloigné du service actif? Il est réellement à regretter qu'une non-activité occasionnée par des infirmités contractées en Afrique (nous en avons la preuve) retarde l'obtention d'une décoration à laquelle une carrière déjà longue et honorablement parcourue lui donne tant de titres." Cet appel fut entendu: le Capitaine F. Renauld reçut le grade de Chevalier de la Légion d'Honneur, le 7 juillet 1884. Mais, souffrant de plus en

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plus de sa gastralgie, handicapé, en outre, par un paquet variqueux qui lui prenait la jambe droite jusqu'à l'aine, F. Renauld fut admis à la retraite, sur sa demande, le 8 mars 1887.

Si son état physique l'empêchait d'être pleinement utile à la tête d'un détachement de cavalerie, F. Renauld n'envisageait pas pour autant un arrêt total de ses activités militaires. Aussi, dès 1885 (témoin ce questionnaire rempli à Vesoul le 19 août 1885), il postule au poste de Commandant du Palais de Monaco, fonction qui devait être moins éprouvante pour lui. Par Ordonnances Souveraines en date du 24 janvier 1888, il fut nommé Chef d'Escadron d'Etat-Major et Commandant du Palais. Le 5 février 1888, après avoir prêté serment devant le Baron de Farincourt, Gouverneur Général du Palais, il entra au service du Prince Albert 1° de Monaco. Il resta en fonction jusqu'en avril 1893, date à laquelle le Commandant Jeanmaire le remplaça.

L'annee 1895 fut particulièrement remplie. F. Renauld se marie avec Julie Léonie Thérèse Paul (née en 1866) et fonde à Vesoul, avec X. Vendrely, Recroix et d'autres, la Société d'Études des Sciences Naturelles du Département de la Haute-Saône.[1] Cette nouvelle société tint sa séance inaugurale le 7 avril 1895 et fut autorisée par un arrêté préfectoral du 27 avril 1895. Dès 1896, elle compte déjà une centaine de membres et édite son premier bulletin. Mais si belle soit l'initiative, l'enfant se meurt rapidement. Et, le 13 juillet 1897, un des fondateurs, Mr. Recroix, fondé de pouvoir à la Trésorerie de Vesoul, écrit à Renauld: "Vous demandez des nouvelles de la société; elle agonise depuis votre départ. Nous étions quatre à la réunion générale: le bureau et Mr. Petitclerc; j'étais d'avis de lever la séance, mais mes collègues ont tenu à délibérer [. . .] il a été décidé de vous nommer président honoraire [. . .] je n'ai pas encore acquitté ma cotisation et je m'en applaudis, car, du train où vont les choses, je crois que ce serait de l'argent perdu. Mr. Lhomme a obtenu de faire figurer à l'exposition scolaire votre catalogue, le 1°bulletin de la société (qui sera sans doute le dernier) et un exemplaire des statuts; ce n'est pas cela qui fera revivre le moribond." En plus de l'Editorial, Renauld insérait 2 articles dans ce bulletin: "Note sur quelques muscinées rares ou intéressantes constatées dans la Haute-Saône de 1893 à 1894" et "Étude sur l'influence du terrain sur la distribution des plantes" (déjà publié dans *Mém. Soc. Emulation Doubs* 1893: 202–213). En 1897, en raison de la santé de sa femme et celle de son fils Paul (né en 1896), F. Renauld quitte Vesoul pour s'installer à Vence puis à Nice. Là il se consacre autant que

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[1] Lors de la fondation de la Société d'Études des Sciences Naturelles de la Haute-Saône, existait déjà la Société d'Agriculture, des Sciences et des Arts de la Haute-Saône. Cette dernière fut fondée en 1806 par le Marquis de Nailly. Octave Chevassu (3 lettres, 1904), petit neveu du Marquis et cousin de F. Renauld, en assura la présidence de 1894 à 1905. La présence simultanée, dans un même département, de deux sociétés à activité très semblable, peut expliquer la disparition rapide de la Société d'Etudes des Sciences Naturelles. Ajoutons que nous retrouvons Recroix, en 1909, président de la section (en création) Sciences Physiques et Naturelles de la Société d'Agriculture, des Sciences et des Arts.

faire se peut à la Bryologie. En janvier 1908, il vient s'installer à Paris, où il meurt le 6 mai 1910.

Officier d'Académie, Membre de diverses sociétés, telles la Société d'Études des Sciences Naturelles du Département de la Haute-Saône, la Société d'Émulation du Doubs, Le Moss Sullivant Chapter, F. Renauld n'a jamais été nommé Correspondant du Muséum (Paris), contrairement à ce qu'indique Thériot (1910).

"M. Renauld, obligé par sa santé à cesser ses études bryologiques, désire se défaire en bloc de [son] herbier. Il ne conserve que les Mousses des États-Unis d'Amérique, qui forment une collection spéciale." Cette note, accompagnée d'un détail des régions représentées, sans doute publiée en 1908, suscita une rapide réaction de la part du Laboratoire de Cryptogamie du Muséum National d'Histoire Naturelle (Paris). Le 21 janvier 1909, à l'Assemblée des Professeurs du Muséum, le Professeur L. Mangin, Directeur du Laboratoire de Cryptogamie, demande "le concours de la réserve pour l'achat d'une collection de mousses comprenant environ 9000 échantillons et 4000 espèces de nombreuses régions exotiques rassemblées par Mr le Commandant Renauld. L'Assemblée accorde 3000 F sur le prix demandé qui est de 3500 F, les fonds du laboratoire étant notoirement insuffisants pour couvrir un achat de cette importance qui ne peut être différé" (Minute des Procès-Verbaux des Séances de 1909). À l'Assemblée du 24 juin 1909, L. Mangin signale l'entrée de cette collection au Laboratoire; elle est inventoriée par P. Hariot, assistant, comme suit: "Herbier Renauld acquis par le Laboratoire de Cryptogamie—44 paquets, environ 15000 échantillons (collection la plus complète, unique, de mousses de la Réunion, Madagascar etc. . . .)" *(ibid.)*. Il apparaît comme tout à fait probable que les papiers de F. Renauld faisaient partie de cet achat. Ceux-ci comportent des dessins originaux (Harpidiaceae pour "Muscologia gallica" de T. Husnot, les Mousses de Madagascar, les *Leucoloma* . . .), et 826 lettres de 119 correspondants, réparties entre 1870 et 1907 (inventaire de la correspondance, Annexe). Déjà contraint à une activité bryologique réduite durant les années 1904–1906, F. Renauld s'arrêta vraisemblablement de travailler très peu après 1907.

Nous sommes donc face à une correspondance relativement importante. Toutefois, il est à remarquer que certaines années apparaissent beaucoup moins denses: 1882–83, 1888–89 et 1894. Chacune d'elles ne comporte qu'une dizaine de pièces. Cet appauvrissement peut s'expliquer par divers rangements des autographes au Laboratoire de Cryptogamie. La constitution de collections d'écriture semble avoir prédominé l'intérêt tant historique que scientifique que peut représenter une correspondance conservée dans son intégralité.

La bryologie occupe la majeure partie des lettres, ce qui n'est pas une

surprise puisque F. Renauld se consacre très tôt à la botanique et plus spécialement aux mousses. Dès 1870, il entre en relation avec W. P. Schimper, alors savant botaniste connu, et publie son premier travail en 1873: "Aperçu phytostatique sur le département de la Haute-Saône." Lorsqu'en 1874, T. Husnot décide de fonder la *Revue Bryologique*,organe de liaison pour les bryologues, Renauld fait partie de l'aventure avec E. Bescherelle, N. Boulay, J. E. Duby, F. Gravet, L. Piré, l'Abbé Ravaud et E. Roze. Dès lors il entre en relation épistolaire avec la plupart des bryologues du moment, français et étrangers, s'entretenant de dénomination de mousses, de délimitation de familles, de genres, échangeant de nombreux échantillons.

Certains bryologues sont pour lui de véritables et durables amis. Tel N. Boulay qui, de 1872 à 1904, lui adressa pas moins de 78 lettres. Le chanoine n'hésite pas à se confier, lui racontant ses démêlées avec les autorités religieuses qui n'acceptaient guère qu'il fasse tant de botanique, ou encore lui donnant son point de vue sur la situation politique. Professeur de botanique puis doyen de la Faculté Libre de Lille, Boulay désirait acquérir pour son Institut de nombreux herbiers européens et exotiques et la bibliographie s'y rapportant. En même temps qu'il achetait l'herbier Sauerbeck ("au prix fort de 1700 f plus le port. . . c'est l'herbier d'un bryologue de cabinet et non d'un collectionneur dans la nature" précise Boulay à Renauld, le 24.5.1885), il cherchait à obtenir les bonnes grâces de L. Lesquereux pour qu'il lui cède son herbier à bon prix. Les lettres de Boulay et Lesquereux témoignent de l'arbitrage de F. Renauld dans cette affaire. Finalement, Boulay écrit le 24.5.1885: "Quant à l'ami Lesquereux, il vient de vendre son herbier et ses livres au musée de Neuchâtel pour 4500 f. Je n'avais pu lui offrir que 2850 f tout compris." Lesquereux nous explique le 29.6.1885: "C'est vrai je regrette d'avoir vendu mes mousses à Neuchâtel. Mais j'y étais pour ainsi dire forcé pour deux raisons, parce que d'abord c'est à Neuchâtel que j'avais offert mes mousses en premier [. . .] et puis, je reste débiteur à l'alma mater pour les instructions que j'en ai reçues dans ma jeunesse. Mais il est certain que mes mousses auraient été beaucoup mieux appréciées et plus utiles chez M. Boulay qu'elles ne le seront à Neuchâtel où je ne sache pas que personne s'occupe de mousses ni même de botanique." Boulay se consolera avec quelques trois cents espèces américaines et de nombreux échantillons de Californie.

Il est à remarquer que nos deux hommes se considéraient comme appartenant à l'école de W. P. Schimper, auquel ils vouaient une grande admiration, mais Lesquereux ajoute le 7.12.1883: "Je vois maintenant que Schimper a été fort souvent dans l'erreur par un travail trop rapide. . ."

Tout comme N. Boulay, E. Bescherelle avait un caractère entier. Ceci n'empêcha pas Renauld et Bescherelle de nouer une longue amitié. La correspondance, assez dense (37 lettres, 1881–1903), de ce chef de division au Ministère des Travaux Publics, travaillant à Clamart dans son "cabinet de 9 m²," nous met en évidence les différents traits de ce personnage. Portant sur ses contemporains un regard quelque peu acerbe, il ne manquait jamais une occasion d'exprimer sa pensée. Le 27.7.1881 il dit tout net: "Comme ceux qui sont payés pour faire de la botanique ont un profond mépris pour les travaux descriptifs qui ne mènent pas à l'Institut, force est aux amateurs de prendre leur place, tant pis pour eux. Nous sommes de ce nombre, et je nous en félicite." Le 22.10.1890, C. Müller se voit fustigé par ces mots: "Je ne partage pas complètement les vues de C. Müller. Il *jordanise* trop et est trop disposé à considérer les mousses comme spéciales à telle ou telle île surtout quand ce n'est pas lui qui les a nommées le premier," et le 22.7.1897, Bescherelle s'en prend au Général Paris: "Le général pompier s'est embrouillé dans ces deux genres (*Conomitrium* et *Octodiceras)* et son *Index* est en défaut, mais ce n'est pas le seul cas." Mais ce pourfendeur, objectif et lucide, se décrit ainsi dans sa lettre du 29.9.1893: "J'écris quand j'ai quelque chose d'important à demander à un confrère ou lorsque j'ai à le remercier, et encore faut-il que j'attende que je sois dans un de mes rares accès de philanthropie, ce qui ne se présente pas souvent, la misanthropie étant le fond de mon caractère, état qui convient parfaitement à l'étude des mousses et qui m'a permis, depuis 25 ans surtout, de publier un certain nombre de florules, qui pourront servir de base à des travaux plus complets." Et si le 1.2.1899 il "maltraite" encore C. Müller par cette phrase: "Il peut se flatter d'en avoir pondu des milliers d'espèces dont un grand nombre viendront embarasser les flores d'une synonymie encombrante," il encourage son ami Renauld par ces mots: "La dualité Renauld-Cardot a donc pris fin! Ça devait arriver, maintenant votre devoir est tout tracé: faire des monographies de genres ou de familles. Les matériaux ne manquent pas." Cette amitié prit fin avec la mort de E. Bescherelle le 26 février 1903, alors que le 28.10.1902, ce dernier indiquait à Renauld: "J'ai cédé mes doubles exotiques au British Museum et mes mousses d'Europe au Minnesota (États-Unis). Je n'ai gardé que mes types collés qui iront au Muséum quand je ne serais plus."

Au nombre des amis de F. Renauld, il faudrait encore citer et écouter: J. Cardot (43 lettres, 1884–1907), avec qui il publia de nombreux articles; le Frère Héribaud (39 lettres, 1884–1907), professeur au pensionnat de Clermont-Ferrand, qui le mit en rapport avec le Frère Rodriguez (collecteur à La Réunion) et d'autres collecteurs; l'abbé Hue (20 lettres, 1890(?)–1907(?)), lichénologue, avec qui les relations religieuses furent étroites (le Laboratoire de Cryptogamie a hérité de son herbier, de sa

bibliothèque et de sa correspondance); etc.

F. Renauld ne s'entretint pas seulement avec des botanistes connus. Il garda avec les amateurs "éclairés" d'excellentes relations, et surtout avec ceux de la Franche-Comté, sa terre natale: tels J. Paillot (1829–1891), pharmacien à Chaprais, près de Besançon (Doubs), X. Vendrely, pharmacien à Champagney (Haute-Saône) — tous les trois publièrent "Flora Cryptogamia sequaniae exsiccata," 1873–1897, C. Flagey (1830–1898), ingénieur civil originaire de la Haute-Saône, installé en Algérie et aussi lichénologue. Il sut se servir de ses relations militaires pour susciter des collecteurs ou obtenir des renseignements géographiques ou bibliographiques.

Ainsi, en tant que Commandant du Palais, de 1888 à 1893, F. Renauld tira de nombreux avantages de son séjour à Monaco. Grâce au "mecénat" de S.A.S. le Prince Albert 1°, le "Prodrome de la flore bryologique de Madagascar. . . ," couronné du prix Montagne, put paraître en 1897. Cet ouvrage doit beaucoup à Gustave Saige (20 août 1838–5 décembre 1905), conservateur des Archives et de la Bibliothèque du Palais. G. Saige dirigeait la collection des documents historiques publiés sous les auspices de S.A.S. le Prince; il ouvrit avec le Prodrome de F. Renauld la nouvelle série "documents scientifiques." Les deux hommes entretinrent, semble-t-il, d'étroites relations. Par la suite, G. Saige s'occupa de l'impression et de l'édition de la Monographie des *Leucoloma* (prix Desmazières) dont la parution fut retardée par la mort de G. Saige en 1905.

Ainsi, les relations avec la Principauté de Monaco se sont poursuivies longtemps après le départ de Renauld. Le Prince Albert lui témoigne son amitié en lui faisant transmettre ses félicitations pour le prix Montagne (1896) par son secrétaire Jean Blanchy (30 janvier 1855–27 janvier 1927), et par Adolphe Fuhrmeister (25 juillet 1855–14 février 1931), son conseiller privé, pour le prix Desmazières (1905), et surtout en lui permettant de publier ces deux documents couronnés, ouvrages reflétant très bien la façon de travailler de F. Renauld.

C'est aussi à Monaco qu'il se lie avec Jules Richard (18 novembre 1863–24 janvier 1945), zoologue, alors secrétaire aux travaux scientifiques, et qui devint le premier directeur du Musée Océanographique de Monaco. J. Richard lui fit parvenir des échantillons des Açôres récoltés en 1896 par lui-même et Minelle, et d'autres du Spitsberg, collectés par Richard et Neuville lors de la campagne de la "Princesse-Alice" en 1898. De cette dernière région, Renauld lui dédia la var. *richardi* du *Mnium "hemenophyllum"* [sic]. Alors que le Prince l'invitait à publier les résultats de la campagne du Spitsberg dans une revue de botanique, Renauld, semble-t-il, ne fit rien paraître à ce sujet. Notons encore que J. Richard, d'après la lettre du 28.1.1901, facilita les relations entre Renauld et A. Engler, directeur du Museum de Berlin, pour l'obtention d'échantillons (sans doute des *Leucoloma*).

Une autre personnalité de l'entourage du Prince, le Baron Jules de Guerne, chargé des travaux zoologiques à bord lors des campagnes de S.A.S. le Prince, lui permit de se mettre en rapport avec le Père Paul Camboué, missionaire à Madagascar.

C'est apparemment grâce aux relations nouées à Monaco que Renauld put commencer ou du moins poursuivre l'étude des muscinées de Madagascar. Il reçut quelques lettres de ses collecteurs, tels le Père Camboué (3 lettres, 1889–1896) qui devint en 1896 professeur de Malgache à l'école coloniale de Paris et Procureur représentant de la Mission Malgache en France, le Père G. Arbogast, curé de Sainte-Marie de Madagascar (1 lettre, 1890) qui a récolté avec le Capitaine G. Chenagon (2 lettres, 1890),[2] le Dr. Besson (1 lettre 1897), vice-résident de France à Fianarantsoa.

Alors que ces collecteurs ont eu une correspondance peu prolixe, il en va tout différemment de E. Delamare qui, de Miquelon, adressa à Renauld 16 lettres entra 1884 et 1887. E. Delamare (26 mars 1835–2 juin 1888), médecin de 2° classe de la marine, en poste à Miquelon depuis 1858, se révèle un récolteur infatigable. "Je remasse," dit-il dans une lettre du 12.2.1885, "tout ce qui me paraît digne d'intérêt: cryptogames, phanérogames, oiseaux, poissons, insectes même, quand le temps me le permet." Le Gallo (1948) ajoute: "Il partait à la montagne avec sa boîte d'herborisation et son fusil en bandoulière suivi de ses deux chiens de chasse." Mais le 4.11.1887, il rechigne quelque peu: "La belle saison s'avance. Soyez certain que je ne vois oublierai pas. Arnold, Viaud-Grand-Marais, l'abbé Dominique (pour les coléoptères) et *tutti quanti* me demandent, qui des insectes, qui des plantes, en nombre, ce qui veut dire une cinquantaine d'échantillons de chaque espèce. Comment faire pour contenter tout le monde. Décidément les naturalistes sont féroces et n'ont pas pitié de moi." Les phanérogames seront déterminés par E. Bonnet (Muséum, Paris), les lichens par Viaud-Grand-Marais, Arnold et quelques-uns par Nylander. Delamare indique à Renauld que, pour les récoltes à Langlade, deux gendarmes, Joubert puis Heurtel, l'aident efficacement. Le 2 octobre 1886, il est noté ainsi: "Ses loisirs sont consacrés à des études fort intéressantes de botanique et c'est à son zèle que la colonie est redevable de la plupart des objets d'histoire naturelle qu'elle a pu envoyer aux expositions." Mais le jury de l'exposition d'Anvers en 1886 fut plus sévère en attribuant, au Comte de Saint-Phalle, la médaille d'argent pour l'importance de sa collection de mousses et de lichens, malgré des erreurs

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[2]Georges Noël Julien Chenagon (31 mai 1854–25 janvier 1930), agent civil des Ponts et Chaussées, s'engage, le 24 avril 1875, dans l'Infanterie de Marine. Il effectue 25 campagnes: Conchinchine, Tonkin (1881–1886), Madagascar (1888–1890), Guyane, Antilles, Tonkin (1892–1895), La Réunion (1898–1900), Tonkin (1903–1905). Capitaine, lorsqu'il récolte les mousses pour F. Renauld en 1890, il fut nommé Colonel en 1904, et admis à la retraite en 1907. Mobilisé en 1915, il cessa toute activité militaire le 30 september 1917.

de détermination; et une médaille de bronze "au Dr. Delamare pour son herbier de plantes phanérogames et cryptogames plus spéciales aux îles St Pierre et Miquelon, cet herbier ne contenait que 250 espèces [. . .] mais on y remarquait de belles algues et de beaux lichens" (E. Lami: Rapport sur les travaux du Jury de la classe III: Enseignement supérieur. Exposition d'Anvers *in* lettre du 6.7.1886). Rappelons ici que le Comte de Saint-Phalle fut Commandant de la Colonie, îles de Saint Pierre et Miquelon, de 1880 à 1886. Si la "Flora miquelonensis" de Delamare, publiée avec F. Renauld et J. Cardot, fut en quelque sorte le couronnement de ses activités botaniques, il remplissait "ses fonctions souvent ingrates et pénibles de médecin pour Miquelon et Langlade avec un dévouement qui ne s'est jamais démenti" (note du 2.10.1886). À Miquelon, il était aussi juge de paix et notaire. Il fut présenté comme "un homme d'une grande déférence pour l'autorité, très conciliant, très sociable, d'un esprit droit et éclairé, ayant toute le confiance de la population en tant que médecin, mais aussi en tant qu'homme moderne, exerçant son art avec zèle, dévouement et désintéressement. Très intéressé par la recherche. Etudiant les tourbières de Miquelon, il vulgarise auprès de toute la population de Saint-Pierre et de Miquelon l'emploi de la tourbe. Il s'était fait un nom dans le monde savant par ses collections de plantes et de lichens, ainsi que par ses études des cryptogames."

S'il n'apparaît pas nettement comment E. Delamare est venu à correspondre avec F. Renauld, la liaison I. Franc—F. Renauld—I. Thériot est plus claire. Isidore Franc (1879–1969), né à Fonvent-le-Haut (Haute-Saône), arriva à Nouméa (Nouvelle-Calédonie) en juillet 1904 comme instituteur à l'école Frédéric-Surleau. Il collecta les phanérogames pour son ami G. Bonati (1873–1927), pharmacien de 1° classe à Lure (Haute-Saône). Le père de G. Bonati était lui-même pharmacien à Conflans (Haute-Saône) et fut membre de la Société d'Études des Sciences Naturelles de la Haute-Saône, fondée par F. Renauld. Ainsi nous retrouvons notre ami en correspondance avec I. Franc dès 1905. Les 6 lettres adressées par ce dernier de 1905 à 1907 nous permettent d'affirmer que Renauld encouragea beaucoup l'instituteur à la récolte des muscinées en Nouvelle-Calédonie. Ce qui ne fut pas chose aisée, et Franc ne s'en cache pas: "Peut-être vais-je vous étonner, mais la préparation, le classement des mousses, ont le don de me fatiguer énormément" (26.11.1906); il ajoute le 18.3.1907: "Les mousses ont le don de m'énerver énormément"; et enfin le 5.7.1907, il écrit: "Puisque vous me le demandez, je veux bien continuer à rechercher mes mousses dans mes excursions botaniques." Le premier envoi, via G. Bonati, ne parvint à Renauld qu'en 1907. Celui-ci déjà fatigué et malade, ne put entreprendre cette nouvelle étude et transmit le relais à I. Thériot. La correspondance d'I. Franc à I. Thériot (une vingtaine de lettres conservées au Laboratoire de Cryptogamie) débute en

octobre 1907 pour s'achever en 1922. Rappelons que M. Le Rat, instituteur à Nouméa, récoltait, déjà avant la venue de Franc, des mousses qui furent déterminées par le Général Paris.

Ces quelques exemples font apparaître combien la correspondance reçue par F. Renauld se révèle intéressante tant pour le bryologue que pour l'historien des sciences. Pour compléter cette étude, il aurait fallu exposer la façon dont E. Levier tenait son herbier, dressait le "portrait miniature" des *Riccia;* découvrir le point de vue de N. Boulay, de J. B. Saint-Lager,[3] ou de E. Bescherelle sur la notion d'espèce; mettre au grand jour la politique d'influence régentant l'attribution des prix Desmazières et Montagne; détailler les relations entre F. Renauld et J. Cardot ou le Général Paris. Et, si ses correspondants français tiennent une bonne place dans les relations entretenues par Renauld, les lettres de V. F. Brotherus, de H. N. Dixon, de C. Warnstorf, ou encore celles de G. Venturi ne manquent pas d'intérêt.

Pour terminer, laissons au rapport militaire le soin de nous décrire F. Renauld: "cheveux: ?-sourcils: châtains foncés-yeux: gris-front: ordinaire-nez: long-bouche: moyenne-menton: pointu-visage: ovale-taille de 1 m 80," et le mot de la fin à V. F. Brotherus (in Thériot, 1910): "Notre ami F. Renauld est un des hommes les plus nobles que j'aie jamais connus."

Cet article a été rédigé en hommage à Geneva Sayre, qui, par son enthousiasme, a su me gagner à sa conviction de l'intérêt de tout manuscrit. Je remercie vivement le Pr. D. H. Pfister de m'avoir accepté parmi les collaborateurs de ce volume jubilaire.

INVENTAIRE DE LA CORRESPONDANCE RECUE PAR F. RENAULD

Amann, J. 3, 1894–1896)
Arbogast, G. (1, 1890)
Arbost, J. (1, 1907)
Arcangeli, J. (1, 1892)
Arnell, H. W. (3, 1895–1901)
Artaria, J. A. (4, 1898–1899)
Baker, C. F. (1, 1902)
Bescherelle, E. (37, 1881–1903)
Besson, Dr. (1, 1897)
Blanchy, J. (2, 1895)
Bonati (1, 1907)
Bonati, G. (1, 1907)
Bornet, E. (3, 1895–1905)
Bottini, A. (14, 1883–1907)
Boulay, N. 78, (1872–1904)
Boule, M. (3, 1899–1905)
Braithwaithe, R. (1, post. 1897)
Britton, E. G. (9, 1898–1907)
Brotherus, V. F. (48, 1878–1907)
Brÿhn, N. (4, 1901)
Burnat, E. (2, 1896–1906)
Camboué, P. (3, 1889–1896)
Cardot, J. (43, 1884–1907)
Chamberlain, E. B. (6, 1906–1907)
Chenagon, G. (2, 1890)
Chevassu, O. (3, 1904)
Contejean, Ch. (9, 1874–1902)
Coppey, A. (1, 1907 ou 1908)
Corbière, L. (4, 1890–1906)
Crépin, F. (1, 1893)
Crozals, A. (1, 1895)
Darboux, G. (1, ?)
Debat, L. (5, 1881–1902)
Delamare, E. (16, 1884–1887)
Demetrios, Ch. (3, 1892)
Dixon, H. N. (15, 1897–1903)

[3]Jean-Baptiste Saint-Lager (1825–1912), médecin, botaniste lyonnais, bibliothécaire de la Société Botanique de Lyon. Ses connaissances philologiques latines et grecques l'ont amené à formuler des remarques sur la nomenclature. Il poursuivit des recherches méthodiques sur l'origine des noms, les herbiers, l'histoire de la botanique.

Douin, I. (1, 1902)
Du Buysson, R. (1, 1885)
Dusen, P. (2, 1899–1905)
Engler, A. (1, 1901)
Farlow, W. G. (15, 1900–1903)
Fergusson, J. (1, 1880)
Fitzgerald, C. H. (3, 1881–1883)
Flagey, C. (5, 1884–1894)
Fleischer, M. (5, 1904–1905)
Franc, I. (6, 1905–1907)
Fuhrmeister, A. (1, 1905)
Galliéni, Gal. (2, 1904–1905(?))
Geheeb, A. (5, 1889–1904)
Géneau de Lamarlière, L. (1, 1898)
Gevrey, A. (1, 1898)
Gillot, X. (1, 1890)
Grandidier, A. (14, 1890–1905)
Gravet, F. (3, 1883–1886)
Grebe, C. (3, 1892)
Grout, A. J. (2, 1901–1907)
Guerne, J. de (1, 1890)
Guignard, L. (1, ?)
Haute Marcailhou d'Aymeric (1, 1895)
Héribaud, J. (39, 1884–1907)
Holt, G. A. (1, 1886)
Holzinger, J. M. (14, 1899–1906)
Hue, Abbé (20, 1890–1907 (?))
Husnot, T. (2, 1876–1906)
Hy, F. (2, 1898)
Jeanbernat, E. (10, 1878–1885)
Junk (1, 1902)
Kindberg, N. C. (13, 1888–1906)
Lacouture, Ch. (9, 1904–1907)
Langeron, M. (1, 1898)
Lesquereux, L. (19, 1881–1887)
Lejolis, A. (10, 1884–1895)
Levier, E. (9, 1901–1903)
Limpricht, G. (2, 1881)
Lloyd, J. (2, 1890)
Loeske, L. (3, 1903–1905)
Lugo, A. de (1, 1877)
Malinvaud, E. (2, 1905–1906)
Magnin, A. (1, 1898)
Magnier, Ch. (1, 1884)
Miègeville, Abbé (2, 1877–1885)
Mönkemeyer, W. (9, 1904–1907)
Motelay, Ch. (1, 1899)
Mourot, M. (1, ?)
Müller, C. (13, 1889–1898)
Nicholson, E. (3, 1901–1902)
Nylander, W. (2, 1891)
Orzeszko, M. N. (1, 1906)
Osterwald, K. (1, 1905)
Paillot, J. (6, 1873–1884)
Paris, Gal (25, 1898–1907)
Paterson, J. (1, 1897)
Perrot, Frères (1, 1896)
Philibert, H. (25, 1879–1901)
Rames, B. (3, 1876–1888)
Réchin, J. (1, 1907)
Recroix (1, 1897)
Richard, J. (6, 1889–1901)
Röll, J. (3, 1894–1896)
Roth, G. (1, 1896)
Rouy, G. (1, 1899)
Saige, G. (5, 1896–1898)
Saint-Lager, J. B. (19, 1889–1907)
Saint-Yves, A. (1, 1907)
Sanio, C. (10, 1886–1890)
Schimper, W. P. (5, 1870–1873)
Slater, M. B. (2, 1892)
Spruce, R. (3, 1881–1886)
Stephani, F. (36, 1887–1901)
Thériot, I. (19, 1901–1907)
Trabut, L. (1, 1907)
Trelease, W. (2, 1896–1898)
Trimen, H. (1, 1887)
Vendrely, X. (2, 1873–1874)
Venturi, G. (14, 1881–1895)
Warnstorf, C. (26, 1885–1905)
Wheldon, J. A. (1, 1907)
Zetterstedt, J. C. (1, 1880)
Zickendrath, E. (1, 1892)

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ATKINSON, FARLOW, AND THE LATER STARTING POINT DEBATE

Donald H. Pfister*

"The name is merely a medium of exchange by which we convey to others the concept of the organism with which we are dealing, and a name employed in accordance with principles adopted by an international representative assembly of botanists is more useful than an invalid name."

(G. F. Atkinson, Bot. Gazette *49*: 149–151. Review of *The Genera of Fungi*)

Between 1904 and early 1910, George F. Atkinson (1854–1918) and William G. Farlow (1844–1919) discussed in letters and in person what had become known as "the nomenclature question." The question dealt with international acceptance of standardized rules of nomenclature. Among the topics considered was the designation of nomenclatural starting points, both for vascular plants and cryptogams. During the six year period betwen 1904 and 1910 Atkinson and Farlow discussed starting points and came to lead the fight for later starting point dates for fungi and, in Farlow's case, for other groups of cryptogams. It is my purpose to document, from correspondence, some of the discussion between Farlow and Atkinson.

By 1900, many thought it desirable to establish rules of nomenclature which would be accepted by botanists throughout the world. Much of this was seen in terms of priority. Robinson (1907) wrote of the tendency of "some recent writers. . . to criticize rather harshly the earlier botanists for making any exceptions whatever [to priority]."

The nomenclature question was discussed in connection with the Paris Congress of botanists held in 1900. Commissions were formed to consider proposed legislation to be presented and discussed at the International Botanical Congress to be held in Vienna in June, 1905.

Following the Paris meeting, proposals were put forth. Among these was a proposal by a group of American botanists (Arthur et al. 1904), which came to be known as the "American Code." It was a type-based Code which called for a Linnaean starting point for all groups as well as other departures.

At the Vienna Congress in 1905, the Paris Code of 1867 was accepted as a basis of an International Code. The "American Code" was defeated. The *Species Plantarum*, first edition, 1753, was designated as the point of departure for vascular plants. For cryptogams, no starting points were designated; the question was referred to a commission which was to report to the Brussels Congress in 1910. Both Farlow and Atkinson were named members of the commission, along with several other Americans.

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*Farlow Reference Library and Herbarium of Cryptogamic Botany, Harvard University, Cambridge, MA 02138.

Of the commission, only Farlow and Atkinson had not supported the "American Code." Throughout the debate, Farlow and Atkinson were opposed to the "American Code."

Atkinson wrote Farlow later (March 7, 1909): "It is a disgrace to American Botany that this bandwagon should be put forward so seriously as the American Botany." Before that, Robinson (1907) wrote that, "To some it has seemed best to devise an ideal system and then, without much reference to the wishes or convenience of their colleagues, to apply it in local publications. The idea of such writers has been, if we understand it rightly, that a system of rules, if devised with sufficient care, would ultimately gain adherence and be recognized as worthy of general adoption."

The Farlow-Atkinson correspondence on nomenclature began just before the Vienna Congress. On July 12, 1904, Farlow wrote to Atkinson: "You ask whether I am going to Vienna. That depends on the printer. I shall go if I can get away. I notice that the Belgians, Swiss and others exclude Thallophytes from their circulars. It looks as if committees might be appointed at Vienna to consider the case of Cryptogams and not force them into the same category of Phaenogams. There is no reason in the world why, because one date is fixed for starting with phaenogams, that cryptogamic botanists should be forced to accept a date long before there was anything definitely known about cryptogams. But, unfortunately, those who are sticklers for priority regardless of sense, have a bee in their bonnet and believe in an ideal symmetry and invariable rule—which they cannot apply, unfortunately."

Farlow did not go to Vienna. He was at the time reading proofs for his *Bibliographic Index of North American Fungi*. But he accurately guessed what the outcome of the deliberations might be. Atkinson attended the Congress, but even earlier he raised the question of starting point. He wrote (Dec. 13, 1904): "I agree very heartily with you that the date for the starting point should be later for the lower plants especially fungi and algae and perhaps also for the Bryophyta. I should rather see it put later than 1800 than even at that date."

Donk (1957) has pointed out that priority or rather a limitation of priority was the main reason for proposing later starting points for fungi. He wrote, "It is quite plain that the acceptance of the later starting points ruled out at one stroke quite a good many embarrassing old names. . ." The introduction to the *Bibliographic Index of North American Fungi* states Farlow's views at the time of the Vienna Congress in much the same way: "We have no scruples in declining to accept many of the names of older writers which have of late been substituted for more modern names since from the vagueness of the descriptions and crudeness of the illustrations, it is impossible, in the absence of original specimens to be sure that the species were the same as those to which they have since been applied." Priority at the time, of course, had at its forefront Otto Kuntze, who de-

fended in nearly every forum the laws of strict priority and a Linnaean 1735 starting point.

In cryptogams, a later starting point went a great way toward eliminating questionable names. This point is raised repeatedly in the Farlow-Atkinson letters as well as in letters exchanged between E. J. Durand and Farlow. On Jan. 22, 1909 Durand, who had written an article advocating Persoon's *Synopsis Methodica* as the starting point book (Durand 1909), wrote to Farlow, "Regarding the starting point for mycological nomenclature, I can say frankly that my principal desire is to have those old indefinite names finally disposed of."

Though Farlow and Atkinson discussed at length limiting priority by proposing *genera conservanda*, Farlow particularly turned his attention to choosing appropriate starting point books. He wrote (Jan. 18, 1909): "I think that Fries' *Systema* is better than Persoon's *Synopsis*. The fact that the date is 1821–32 does not seem to me to be a difficulty . . . The difference between 1801 and 1821–32 is not great enough to counterbalance the facts that Fries' *Systema* has many more species and genera than Persoon and that in general the classification of Fries is more scientific and modern than Persoon's. Furthermore, Fries as a rule includes what is best in Persoon and the latter is practically not left out in the cold by adopting Fries."

Atkinson agreed (Jan. 22, 1909), "Taking up the question of the proposed motions relating to the rules for the nomenclature of the fungi, I may say that I have no preference as between Persoon, 1801, and Fries' *Systema* with several dates. I recognize, as you suggest, that in some respects, at least, Fries' work is more scientific and it certainly does include a larger number of species. I am willing to accept whatever date the majority of mycologists are agreed upon."

During late 1909, Atkinson and Farlow worked on proposals for the Brussels congress. Proponents of the "American Code" again published proposals. The question was raised and discussed at several meetings of the Botanical Section of the AAAS and several papers by various factions appeared in *Science*. The Atkinson-Farlow proposals, endorsed by many mycologists were published in March 1909.

The wording of the proposals reads, "Art. A. Mycological nomenclature starts with the Systema mycologicum of Fries, 1821–1832, with the exception of the genera listed in the nomina conservanda (See Art. B) which are to be exempt from the action of the rule of priority, and with the further exceptions relative to form genera and species."

As has been seen, Farlow and Atkinson were not oblivious to the role of starting point and its limitations or complications in dealing with post-Linnaean pre-starting point names; indeed, this was their main motivation. But still they could not wipe the slate clean. How could they use the pre-Friesian names and tie them to the literary basis of pre-1821 names?

In the proposals prepared by Atkinson and sent to Farlow, Atkinson provided one solution. He wrote to Farlow (Jan. 23, 1909), "I am sorry you did not make some comment on the paragraph relating to the retention of the name of the author of Linnaean or post-Linnaean species in case that species name was adopted by later students and was otherwise valid. Names of pre-Linnaean species cannot be retained because of the Vienna rules forbidding it. But it seems to me that in this respect, where there are no other serious objections, we might allow this usage to extend as far back as L. 1753. Thus, *Boletus edulis* Bull. not *B. edulis* Pers. (of 1801) or *B. edulis* Fr. (of Systema) . . . This clause also might be perhaps a small consolation prize for those opposed to our views, in case a later date than 1753 is adopted."

Farlow (Jan. 24, 1909) responded, "I have had a talk with Robinson on the subject. As far as *species* are concerned of course the phaenogamists have nothing to correspond because previous to 1753 the binomial nomenclature was not used and therefore prae-Linnaean specific names could not be quoted. In our case it is different because after Linnaeus and previous to Persoon, if Persoon is adopted, there were binomial specific names. I learn that the use of brackets [ ] and parentheses ( ) as used in the case of *genera* could be used by us if thought best. *Ustilago*, for instance, if used as a Persoon genus, was also used by Bauhin and I believe earlier by Lobelius and, if I understand Robinson rightly, *Ustilago* [Lob.] means that although we use *Ustilago* as used by Persoon, the name *Ustilago* was first used by Lobelius. N.B. I am sure that Bauhin used *Ustilago* for oat smut and he refers back to Lobelius but I have not time today to look up Lobelius and therefore the illustration I give must be regarded as provisional. On this principle, we *could* say *Boletus edulis* [Bull.] since Bulliard used the name *B. edulis* before Persoon and in the same sense. One could not, however, treat the name *Amanita caesarea* in the same way since Scopoli did not say *Amanita* but *Agaricus* and one would have to say *Amanita caesarea* (Scop.) Pers. Whether admisable to adopt this practice is an open question, the trouble being that some mycologists would go back of Persoon for authorities of a very doubtful character. It is plain that Scopoli's *Ag. caesarius* was *Am. caesarea* Pers. but there are many cases which are far from certain but there are mycologists (e.g. Bresadola) who 'know all about it.' "

Atkinson (Jan. 26, 1909) responded agreeably, "It would, it is true, encourage some to go back to early dates, but according to the rule they could only go back in case a post-Persoonian and post-Friesian author used the earlier name before some one else used a different name, which would exclude a great many."

E. J. Durand, then at Cornell, also had some words about starting point and the pre-starting point authorities. After giving the example of *Octospora leucoloma* Hedw. and its usage, he writes Farlow (Feb. 22,

1902), "This [citing pre-starting point authorities] seems to me to be exactly like going back of 1753 for names of flowering plants, or rather for names of authors. I do not approve of this at all. No one knows nor did Fries know whether the plant he had in hand was the same as the one described by Hedwig, for the reason that Hedwig's species is too imperfectly described to be recognizable. Now it seems to me that the whole object of adopting a special starting point for the fungi is that these old indefinite names may be cut out, and that all reference to them may be abolished. If we adopt the name *leucoloma* Hedw. and all similar names, how are we gaining anything from our special starting point? How much better off will we be than now? It seems to me that to legislate that Hedwig's name shall be added is to legislate Hedwig's plant as the same as the one Fries had which seems to me ridiculous. . . It appears to me that Prof. Atkinson's rule adopts a starting point and then kicks over the whole thing with all its advantages, and that if his rule is adopted, we might better not have a special point of departure but go back to 1753. I think that if a special starting point is adopted, everything prior to it should be ignored as if it were swept out of existence. . . no middle ground is possible, or at least feasible. . . I have used all the arguments at my command with Professor [Atkinson] without effect. It is a sort of pet of his." The Article was included in the proposals.

In early 1909, when the "American Code" proposals were circulated, Farlow, at least, decided on his strategy. He wrote Atkinson (Feb. 22, 1909), "After receiving the N.Y. resolutions, I made up my mind the only thing which had better be done on the part of those opposed to the N.Y. plans would be to make a clear and strong statement of the desirability of not going back to the Spec. Plant. in the case of cryptogams. As far as fungi are concerned, although it seems to me that Fries' *Systema* is better than Persoon's *Synopsis*, I am perfectly willing to adopt Persoon if the majority prefer him to Fries. . . In short, these are my ideas. At Brussels, the great fight will be on the questions: Shall we go back to the *Spec. Plant.* for cryptogams or not and shall genera conservanda be allowed. The former is the great special question for Brussels. The latter is to bring a renewal of the fight at Vienna. For us, we should concentrate on the first question. . ."

Others were debating the same topics and publishing arguments. Saccardo (1909) spoke for 1753; Durand (1909) advocated Persoon. Farlow privately printing an extensive paper, "A Consideration of the Species Plantarum of Linnaeus as a basis for the starting point of the nomenclature of Cryptogams" (1910a). In this he set forth his views on Fries' *Systema* as a starting point, propounding on the inadequacy of Linnaeus in all cases for cryptogams. The paper was an expanded version of the paper presented at the AAAS meeting in Boston on December 29, 1909. "By adopting a work like Fries' Systema," he wrote, "the dreary and

unnecessary labor of trying to account for all the vague names given by older writers and the perpetual changing of names long in use and well understood in consequence of what are often no more than conjectures as to what the older species were would be avoided."

But even Farlow—before the Congress—had doubts about what could be accomplished. He wrote (Mar. 3, 1910), "I am not very confident as to what can be accomplished at the congress. The real majority I think really want Fries or Persoon but apparently some who ought to speak out are hedging ready to jump either way. It is doubtful whether Fries will be accepted."

When Farlow and Atkinson sailed for Europe, the situation was far from clear. Farlow, traveling with copies of Persoon and Fries, tried to visit Saccardo in Italy. Saccardo, pleading illness, did not see him. He visited various European mycologists and phycologists but kept in close contact with Atkinson. His final letter before the congress written from Geneva ends with a pessimistic postscript, "I feel that the Congress will be a failure."

We will never really know what discussions took place at the meeting in Brussels since, by Farlow and Atkinson's account in *Science* (1910), we know that after the noon recess on the first day of the meeting of the section on nomenclature, an adjournment was called and an hour of informal conferences took place at which specialists of various groups agreed upon recommendations as to starting point books. With the fungi, the books presented were as follows: Myxomycetes—Linnaeus, *Species Plantarum*, Persoon *Synopsis* for the Uredinales, Ustilaginales and Gasteromycetes, and Fries, *Systema* for the other fungi. The vote was 130 to 4 for the adoption of these books.

Atkinson remained in Europe for the summer; Farlow returned to his summer home at Chocorua, New Hampshire and soon began writing the report of the Congress for *Science*.

Science was a limited forum of postcongress debate. Shear (1910) responded with comments both on the multiple dates voted by the Congress and on the lack of legislation on the question of types. As to the starting point question, he felt that the multiple books could not work satisfactorily.

C. G. Lloyd (1910) was not without comment on the proceedings either, "Botanical congresses, like political conventions in the United States, are governed by a system of trading wherein a few wirepullers in each section direct the matter. Fortunately, from a fungus point of view, the chief pullers in this department (Farlow and Atkinson) had some rather sane ideas and made a late date (Fries) their starting point. However, the 'starting point' in nomenclature of fungi is of about as much practical importance to the student of fungi as is the exact location of the North pole to the average traveler. . . Taking everything together, our

'law-makers' did very well, and personally we are grateful that it was no worse."

DISCUSSION

The proposals of Farlow and Atkinson and the acceptance of a compromise version at Brussels have had a lasting effect upon the nomenclature of fungi. Either as starting point books or dates they have been carried through subsequent codes. In correspondence and published work, Farlow and Atkinson clearly were aiming at cutting off that portion of the literature using binomial names which they judged to contain difficulties. That the Fries-Persoon starting points were artificial in the sense of Donk (1957) was clearly realized by Farlow and Atkinson as witnessed by their concern over how to cite pre-starting point names. Farlow introduced into his arguments a question not previously addressed. That is that of the competence of the starting point author. He stated the starting point book should be comprehensive and "scientific"—certainly subjective standards.

The nomenclatural stalemate which developed after 1910—partly because of the polarizing effect of the American Code—was not broken until 1930 at the Cambridge Congress. It is pertinent to point out that this code was quite different from the Vienna Code. It accepted types; the Vienna Code did not. Farlow and Atkinson did not make their proposals with the idea that one might have to investigate type specimens to use names. In this sense, the starting points as designated were anachronistic when used in 1930. They were the remnants of a discarded Code. Donk (1957) raised the question of the type of a pre-starting point species. Most authors trace the type to the original author whether before or after the starting point. Korf and Kohn (1980) write that "Persoon and Fries did not work solely as creators; their works stand on the accumulated research of their forebearers [sic]. The Code does not destroy that historical basis by providing later starting points. The older books must still be consulted to understand what synthesis Persoon and Fries may have done to bring order to the literature of their past."

Farlow and Atkinson perhaps also did not fully realize the difficulties of the multiple dates of Fries or of the difficulties to be found in trying to find validating authors. While the literature of 1821 might now be well known (Petersen 1975–1977), the post-1821 literature has never been systematically worked. Korf and Kohn (1980) have discussed some specific examples where such dating makes critical differences in recording authorities and synonymy.

Perhaps we have tried too long to rid ourselves of uncertain names under a rule proposed for another code, one not based on what we now consider fundamental—that is, the type system. Perhaps now we might be willing to settle for a stricter priority and less time on the still dreary

and unnecessary labor of seeking validating authors. In 1892, E. F. Smith wrote about priority that "There seems almost no end to the changes a persistent rummaging of old literature can bring. . . I most devoutly wish the strict law of priority were at the bottom of the sea." Some of us might now say the same thing about later starting points.

EPILOGUE

Farlow and Atkinson remained interested in the problems generated at the Brussels congress. To the end of their correspondence, at Atkinson's death in 1918, they questioned each other on points of nomenclature. And the two became friends; occasionally in their otherwise formal letters, their friendship showed. Atkinson wrote to Farlow on Apr. 11, 1916, when Farlow was well into his autumn: "I am surprized that spring is a gloomy season for you. It is the season of cheer and optimism for me. Winter is my gloom. It is like the night. I am often gloomy at night, but morning nearly always brings hope and optimism."

ACKNOWLEDGMENTS

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ROBERT HOOKE ON MOSSES*

P. W. Richards**

SUMMARY

After an introduction on R. Hooke (1635–1703) and his *Micrographia* (1665), comments are made on the illustration and text of Observation XXI, "Of Moss and several other small vegetative Substances." The illustration may represent more than one species, of which *Bryum capillare* Hedw. sens. lat. may be one. Attention is drawn to: (1) the lack of reference in the text to the cell structure of the moss leaves in the illustration, (2) Hooke's views on spore dispersal and the possibility of spontaneous generation, (3) a possible reference to moss protonema.

Robert Hooke's *Micrographia or some Physiological Descriptions of Minute Bodies made by Magnifying Glasses with Observations and Inquiries thereupon* (1665) includes 60 'Observations' of which no. XXI is entitled, "Of Moss, and several other small vegetative substances." The text occupies nearly five pages and is illustrated by a page of engravings made, like all the illustrations in the *Micrographia*, from Hooke's own drawings. Both the text and the figures are of great interest and it is remarkable how little attention they have received from bryologists ancient or modern. Among the "fathers of bryology," I can find no mention of Hooke in either Dillenius' *Historia Muscorum* (1741) or Hedwig's *Fundamentum Historiae Naturalis Muscorum Frondosorum* (1782). One of the few references to him in more recent bryological literature is a short note by Yoshimura (1972). My own interest in Hooke's observations was aroused in 1973 by a letter from Dr. M. Neushul of the University of California at Santa Barbara asking me whether I could identify the moss in Hooke's drawings which he was intending to reproduce in a textbook. The scientific interest of Hooke's observations is so great that I would like to make a few comments on them, partly in the hope that someone more learned then myself in 17th century science will be stimulated to study them more closely.

For those who do not have access to the original, there is an excellent facsimile reprint of the *Micrographia* (Dover Publications, 1961); this also includes the index from the abridged *Micrographia Restaurata* of 1780, and a preface and supplementary index reprinted from volume 13 of *Early Science in Oxford* (Gunther, 1938).

ROBERT HOOKE AND THE MICROGRAPHIA

Before considering the chapter on mosses in detail, some general remarks on Hooke and his book are needed in order to put his observations in perspective.

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*The substance of this paper was read at a meeting of the British Bryological Society at Leicester in September 1977.

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Robert Hooke was born in 1635 at Freshwater in the Isle of Wight, England. His father, a clergyman, died when he was 13, leaving him 100 pounds which he used to pay for his further education. As a boy he spent much of his time making mechanical toys, such as models of watermills, sundials and ships, but his first ambition was to make a career as an artist. He moved to London and was for a while apprenticed to the famous portrait painter Sir Peter Lely and to the miniaturist Samuel Cooper. Soon after arriving in London he came to the notice of Dr. Busby, the celebrated headmaster of Westminster School, who befriended him and took him into his house. He was offered a choral scholarship and was persuaded to become a pupil at the school. Here he studied Latin and Greek, of which he already had a fair knowledge, and learned Hebrew and "some other oriental languages." Busby particularly encouraged him to study mathematics and, according to Aubrey's *Brief Lives* (repr. 1949), he mastered the first six books of Euclid in a week as well as inventing "30 severall ways of flying." From Westminster School he went to Christchurch, Oxford, in 1653.

Here, Hooke came into contact with the brilliant group of scientists then working in Oxford who a few years later founded the Royal Society in London. These included Evelyn, Wilkins, the architect Christopher Wren and Boyle (of Boyle's Law). For a time Hooke became what would now be called research assistant to Boyle, and his inventive genius and scientific ability were quickly recognized.

In October 1662 the Royal Society – to give it its full name, the "Royal Society for Improving Natural Knowledge by Experiment" – received its charter from Charles II and, in the following month at Boyle's suggestion, Hooke was invited to be its "Curator of Experiments." The duties were "to furnish the Society every day they meete with three or four considerable experiments, expecting no recompence till the Society gett a stock enabling them to give it." Hooke retained the post of Curator for the rest of his life and a small salary was soon found for him. From 1664 this was supplemented by an income of 50 pounds per annum as Professor of Geometry at Gresham College where an apartment was provided for him. He was that rare phenomenon in the 17th century, a professional scientist living on his earnings. After the Great Fire of 1666, Hooke became one of the City Surveyors appointed to oversee the rebuilding of the City of London and was personally responsible for designing the new Bethlehem (Bedlam) Hospital (demolished in 1814) and several other public buildings.

Hooke was one of the greatest and most inventive scientific minds of his age. He anticipated Newton's inverse square law of gravitation and came near to anticipating Lavoisier's views on combustion.

Many of the "experiments" devised by Hooke were demonstrations rather than experiments in the modern sense, but since the Royal Society

then met once a week, their preparation involved much work. Many of the "Observations" in the *Micrographia* were based on experiments shown to the Royal Society but they were not given in the same chronological order as they appear in the book, where they are grouped more or less according to subject. The experiments and the comments made on them by the Fellows are recorded in the Society's *Journal Book* (Minutes). Hooke's demonstrations of objects seen under his compound microscope evidently aroused much interest and on April 1, 1663, the Society asked him to provide at least one microscopical observation for each meeting. A week later he "shewed the company the appearance of common moss in a microscope" and on October 14 of the same year[1] "Moss grown upon a brick, together with the seed."

Hooke's strongest interests were in the physical sciences and in mechanical devices — it was he who invented the wheel barometer and the spiral balance spring for watches — but it is clear that he took great delight in studying small plant and animal structures. He made some notable contributions to biology of which the best known is the discovery of the cellular structure of plants. He was little interested in taxonomy, though we know from his diary (Robinson & Adams 1935) that he possessed the herbals of Gerard, Parkinson and Lobel as well as other botanical books. He did not actually buy copies of these herbals until 1673 but may well have already been familiar with them when he wrote the *Micrographia*.

Hooke was small in stature and unprepossessing in appearance. He suffered from ill health all his life but he was very sociable and became a well known London character. The dramatist Shadwell in his play *The Virtuoso* lampooned the London scientists of the time, including Hooke, who after seeing the play remarked, "Damned doggs, vindica me Deus, people almost pointed." Pepys (Diary, Feb. 15. 1665) said of him as a young man, "[He] is the most and promises the least of any man in the world that ever I saw." He died in 1703.

HOOKE'S ILLUSTRATION

This appears on page 130 (labelled at top right "Schem. 13") and consists of four drawings reproduced as engravings (Fig. 1). These show:

(1) The base of a young (probably sterile) moss gametophyte (labelled D by Hooke. In figure 1 the D is barely discernible but is on the uppermost dark leaf). The stem and leaves are accurately drawn and the excurrent costa and lamina cells of the latter are clearly indicated.

(2) The broken-off upper part of a fertile female plant showing stem, leaves, rhizoids and the lower part of a seta. The branching of the rhizoids is shown and, as pointed out in the text, the leaves are relatively longer and narrower than in the younger plant.

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[1]This is the date given in the Journal Book but Gunther (1961) gives it as October 7.

FIGURE 1. R. Hooke's illustration to Observation XXI (Of Moss, and several other small vegetative substances). For explanation of lettering, see text.

(3) An immature capsule and calyptra (marked A and B respectively by Hooke). The seta has been cut through below.

(4) A dehisced, probably dry, capsule (F) showing the peristome and the upper part of the seta.

There seem to be some errors in the labelling of the illustration. The leaf referred to as B in the text (p. 131) is presumably the leaf marked D in

figure (1). The "hole" in the middle of the peristome referred to in the text as E (see below) is marked C in the figure of the dehisced capsule (4).

A close inspection of the drawings suggests that Hooke's drawings represent at least two different species. The sterile plant (1) (Hooke's D) can hardly belong to the same species as (2) and (3), although the dehisced capsule (4) might be a third species but could well belong to the same species as (1). It could perhaps be that (1), and possibly (4), were the "common moss" which was shown to the Royal Society on April 8, 1663, and that (2) and (3) were taken from the "moss grown upon a brick together with the seed" which Hooke exhibited on October 14. In attempting to identify the species, it is relevant to remember that after his early years in Oxford, Hooke spent all his adult life in London and seems seldom to have left the town. It is likely that the specimens from which he made the drawings for Observation XXI were gathered near, perhaps within, the City of London, one can well imagine on some old wall. Clearly no certain identifications can be made, but taking all the evidence into consideration, it would be reasonable to suggest that (1) is *Bryum capillare* Hedw. sens. lat. and that (2) and (3) are some other acrocarpous moss, possibly *Barbula* sp. or *Tortula muralis* Hedw. though the upper part of the lamina seems too gradually tapering for the latter. The old dried-up capsule (4) could well be *Bryum capillare* like (1).

It is interesting that though the leaf cells are clearly shown in drawing (1), Hooke does not point out their similarity to the cells he had seen in cork and various plant stems. In the text of Obs. XXI (p. 131) he says: ". . . those Plants that had the stalks growing on top of them [i.e. female plants with setae] had their leaves of a much longer shape, all the surfaces of each side of which, is curiously cover'd with a multitude of little oblong transparent bodies, in the manner you see it express'd in the leaf B [see above], in the XIII *Scheme*."

The cellular structure of cork was demonstrated to the Royal Society on April 15, one week after the "common moss" and it is illustrated and described in Observation XVIII of the *Micrographia*, where the word cell is used for the first time in its biological sense (though, as Westfall (1972) says, Hooke conceived of cells as passages carrying liquids used in plant growth rather than in the modern way as units of organic structure). On page 115 he says: "Nor is this kind of texture peculiar to cork onely" and goes on to mention that the pith of elders and other trees as well as that of various herbaceous plants such as carrots, teasels, some kinds of reeds and ferns has a similar structure. All his examples are from stems, and he does not seem to have observed that the leaves of these plants also have a cellular structure.[2] It has to be remembered that Hooke's microscope (illus-

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[2] "Schem. XV," the illustration to Obs. XXV, includes a drawing of the under surface of the leaf of a nettle (*Urtica dioica* L.). Hall (1966) states that this drawing shows cell walls, but a careful comparison with a living leaf shows that the polygonal areas in the epidermis are vein islets, not cells.

trated in Schem. 1 facing page 1 of the *Micrographia*) had no substage and all his microscopic observations were probably made by reflected light; when using daylight the light was focused on the object by a glass globe containing water or by a "very deep clear plano convex glass" and, when a lamp was necessary, Hooke used both the globe and the lens (*Micrographia*, page 16 of Preface). It is understandable that under these conditions the slightly convex outer cell walls of the lamina in a moss leaf should have appeared to him as "oblong transparent bodies."

THE TEXT OF OBSERVATION XXI

Hooke begins by commending to his readers the beauty and interest of the moss. He says, "Moss is a plant, that the wisest of Kings thought neither unworthy of his speculation, nor his Pen, and though amongst Plants it be in bulk one of the smallest, yet it is not the least considerable: for as to its shape, it may compare for the beauty of it with any Plant that grows and bears a much bigger breadth." The reference to "the wisest of Kings" is to a belief, the origin of which I have not discovered,[3] that "the hyssop that springeth out of the wall" of which Solomon spoke (I Kings, Chapter 4, verse 33, King James Version) was a moss: this is found elsewhere in old botanical literature.

Hooke then goes on to give an excellent account of the structure of the moss, with a surprising amount of detail. "The root," he says, "is almost like a seedy parsnip, furnish'd with small strings and suckers, which are all of them finely branch'd like those of much bigger Vegetables." He describes the capsule as the "seed case" and the calyptra as a "whitish skin B" (referring to the figure on the opposite page), "terminated in a long thorny top" which "at first covers all the Case"; this afterwards "cleaves, and at length falls off." The peristome of the unripe capsule he describes, somewhat oddly, as "like a flat barr'd button without any hole in the middle": in the ripe mature state the "button grows bigger, and a hole appears in the middle of it, E, out of which in all probability the seed falls." He was obviously not aware of the movements of the peristome teeth. He notes that, as the capsule ripened, it turns downward "after the same manner as the ears of wheat and barley usually do." He cut open the capsule with a penknife and saw the spore sac suspended within the capsule by "multitudes of stringie fibres."

Hooke was handicapped by the lack of suitable terms to describe what he was observing. He called the spores "seeds" and perfectly understood their function in reproducing and dispersing the plant. It was not until

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[3]Bacon in *Sylva Sylvarum* (1627) says (pp. 138–139): "The scripture saith that Salomon wrote a naturall history from the Cedar of Libanus to the mosse growing upon the wall (*for so the best translations have it*) [my italics]."

about 100 years later that Hedwig introduced the term spore and discovered the sexual organs of mosses. Naturally, Hooke did not understand the life-cycle of mosses: the concept of two 'generations' was first put forward by Hofmeister nearly 200 years after his time.

After describing the structure of the "Common moss," Hooke then devotes nearly three pages to the ecology and physiology of mosses.

After "the seed was fallen away," he says, "the Case, Stalk and Plant" (i.e. the capsule, seta and leafy gametophyte) grow red and wither. "From other parts of the root" new branches ("slips") appear and become similar to the parts of the moss they replace. He observed that moss could be found "springing, mature, ripe, seeding and wither'd at all times of year. . ." but it flourished and increased most in warm and moist weather.

The moss, Hooke says, gathers its nourishments mostly "Out of some *Lapidescent*, or other substance corrupted or chang'd from its former texture, or substantial form," such as "the rotten parts of Stone, of Bricks, of Wood, of Bones, of Leather etc." He also noted that mosses grow on the bark of trees, sometimes near the ground and "sometimes from some chink or cleft of the bark of the Tree, which has some *putrify'd* substance in it." He thought that the moss on trees was of a different kind from that on "*putrify'd* inanimate bodies and rotten earth." He adds that there are many other kinds of mosses which grow on trees and other plants of which he will make no mention, nor of the "Moss growing on the skull of a dead man, which most resembles that on trees." This last reference is to the "Muscus ex craneo humano" which is depicted in Gerard's Herball (1597) and various other herbals of the period.[4] The idea of moss growing on a human skull seems to have caught the fancy of Hooke's contemporaries.

The short account of the substrata on which mosses may be found leads to a long discussion on whether they grow from "disseminated seed" or may "spring or rise out of corruption." This is an interesting contribution to the arguments about "spontaneous generation" (though Hooke does not use this term): these continued until they were finally settled by the work of Pasteur and others in the 19th century. Earlier in the *Micrographia* he considers the similar problem with reference to blue mould and parasitic fungi on rose and bramble leaves.

As far as the moss is concerned, he points out the difficulty of supposing that "so perfect a vegetable" could arise from the "corruption" of stone or dead organic matter but says: "Whether this Plant does sometimes originally spring or rise out of corruption, without any disseminated seed, I have not yet made trials enough to be very much, either positive or

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[4]The figure in Gerard's *Herball* shows a moss not unlike *Dicranum scoparium* Hedw. growing on a skull. Dr. G. A. M. Scott tells me that the drawings of the *Muscus ex craneo humano* in this and other herbals appear to have been copied, sometimes with embellishments, from a common source which he has not yet certainly traced. See also pp. 145.

negative." He is not willing to dismiss the spontaneous generation theory altogether, but says that one can reasonably imagine that the "seed" (spores), being so small and light, could be carried about in the air, then washed out by rain and in this way dispersed to places "where it finds a convenient soil or matrix for it to thrive in."

Hooke remarks that if moss "arises from corruption" it is strange that substances as different as stone, brick, wood, leather and other dead plant and animal material should all give rise to the same kind of plant. He observed that moss will grow on marble or flint but always the microscope, if not the naked eye, will find "some little hole of dirt in which it was rooted." To show how under the influence of air and water different kinds of "putrifactions" might be able to develop into living plants, Hooke goes into a curious and elaborate analogy between dead and decayed plants and animals and a broken and "disordered" clock. Just as the latter can be repaired and made to work again, the "vegetative principle" and the warmth of the sun might be able to produce a moss from decomposed organic material.

Towards the end of Obs. XXI Hooke argues that though a moss is so small, it is as complete a plant as the "most conspicuous and vastest Vegetables of the world" and "may very properly be reckon'd with the tall Cedar of Lebanon." Just as there may be as much "curiosity of contrivance and excellency of form" in the smallest watch as in a large church clock, and even much smaller plants such as the fungi on the surface of rose leaves may contain "all the contrivances and *Mechanisms* requisite to a perfect vegetable." He then compares the bulk of the moss to that of the largest trees of hot climates such as Guinea and Brazil. The latter, he says, may have trunks 20 ft (ca. 6 m) in diameter,[5] whereas the stem of the moss is not more than 1/16 of an inch (1.6 mm) thick: from these figures he calculates that the bulk of the largest trees is at least 2,985,984 million times as large as that of a moss.

There is, Hooke says, an infinite variety of the "smaller kinds of vegetations" and they would almost fill a volume big enough to make a new herbal if he described them all. In the last paragraph he mentions the "greenish scurf" found on growing trees and any kind of wood, stones, bones, etc. long exposed to sun and rain. In many parts of this "I could not certainly perceive . . . any determinate form . . . but in other parts it looked almost like green bushes, and very confused, but always of what every irregular Figures the parts appeared of, they were always green." Is it fanciful to suggest that Hooke is here describing the protonema of a moss?

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[5]Hooke may have read about the baobab (*Adansonia digitata* L.) of African savannas which is said to grow to a diameter of 30 ft (10 m): in general tropical trees rarely reach a diameter of 20 ft.

POSTSCRIPT

Hooke's interest in mosses did not end with the publication of the *Micrographia* in 1665. On June 11, 1668, Hooke brought to the Royal Society a written account of the "seed of moss' (Gunther 1930, pp. 336–337). Hooke was impressed with the small size and enormous number of the spores in "the common moss." He estimated that 770 million "seeds" would weigh one grain (0.06 gm). He explains his method of calculation and says that though the spores of the moss are "one of the smallest compound bodies I have hitherto taken notice of," the "seeds" of the fungus on rose leaves are even smaller. He adds that, though the "seeds" of the moss are small, "how much smaller must the rudiment of the plant that lies enclosed within it be?"

Hooke describes how he pressed the spores out of a capsule and found that some were ripe and brown or reddish, and that as he pressed "a dust went out of them and vanished into the air." This leads him to speculate once more that the spores could be carried from place to place in the air "to tops of walls, houses and steeples," but concludes that "whether this conjecture is right, further observation must determine." This paper on moss "seed" led to some discussion at the Royal Society the following week (June 18).

On the same occasion Dr. Wilkins moved that "Mr. Hooke be ordered to try whether he could by means of the moss seed shown by him, make moss grow on a dead man's skull." Whether Hooke carried out this instruction is not recorded.

ACKNOWLEDGEMENTS

My grateful thanks are due to the Librarian of the Royal Society for allowing me to consult the Society's *Journal Book* for 1660–1664, and to Mr. Robert Latham, C.B.E., for helping me to locate Pepys' comment on Hooke.

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AN ENGLER EPISODE

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Rarely has plant systematics gone through a period of such feverish expansion and activity as in the Engler-era. This period started with the year 1871, in which Adolf Engler (b. 1844) found his first real scientific position at München as systematist with Carl von Naegeli, and ended with his death in 1930.

In an attempt to understand and perhaps later describe the personality and creativity of Engler as well as his influence on systematics in general, I have tried to find authentic documents illustrating his personality and development, especially for his earlier years.

Diels (Bot. Jahrb. *64*: i–lvi. 1931), the author of an excellent and singularly sensitive biographical account of Engler, mentions the influence of Alphonse de Candolle on the young Silezian botanist. De Candolle's letters to Engler were at Berlin-Dahlem but are now, alas, no longer extant. However, most of the letters written by Engler to the author of the *Phytographie* are still kept at the Conservatoire botanique de Genève. The Director of the Conservatoire graciously allowed me to copy these letters for my Engler studies. In this note honoring Geneva Sayre, who has done so much to further our knowledge of the history of taxonomy, I should like to sketch briefly the picture of the young Engler as it comes forward from the letters at Geneva written between 1875 and 1880. They show in several ways that the young Engler, in a modest subordinate position, provided opportunities for himself to do research and to publish with the same skill which later allowed him to become the driving force behind the *Natürliche Pflanzenfamilien*, *Pflanzenreich*, *Botanische Jahrbücher* and *Vegetation der Erde*, to mention only the most outstanding of Engler's synthetic enterprises.

Early in March 1875 de Candolle approached Engler with a request to treat some groups for his newly scheduled *Monographiae phanerogamarum*. Actually de Candolle must have replied to an earlier letter by Engler (not preserved) in which he asked to receive the Geneva Araceae on loan for his treatment of this family for the *Flora brasiliensis*. De Candolle replied that he could, alas, not send the "Aroideae" for that purpose but invited Engler to participate in his own new project. Engler, answering on 8 March 1875, took the hint and declared himself ready to write up the Aroideae, Saxifragaceae, Rutaceae, Ochnaceae, Burseraceae and Anacardiaceae for the *Monographiae*. In this way, and in this order, he could consult the Candollean collections of Araceae for two purposes, the *Flora brasiliensis* and the monograph. Even so, he states that he regrets de Candolle's initial refusal because St. Petersburg, Brussels, Berlin and

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Vienna had made their Aroid material already available to him. In the next (preserved) letter, on 24 September 1875, Engler reiterates his offer to treat the Araceae, to be followed by the Anacardiaceae. De Candolle had originally approached Solms Laubach to treat the Araceae (this was obviously the reason for his original refusal to send the Araceae to Engler for the *Flora brasiliensis*), but Solms had withdrawn this commitment with the result that Engler's little scheme was successful: de Candolle would let him write-up the Araceae even though Engler's first publication on this difficult family was not yet out. He asks Engler about this work and the latter gives a brief outline in a later letter (31 December 1875) of his morphological and anatomical work on the family. This work ultimately resulted in the "Vergleichende Untersuchungen über die morphologischen Verhältnisse der Araceae" of 1877. This work of a very general morphological character could well form the basis of a taxonomic monograph of the Araceae without having to be part of it and thus retaining the strictly taxonomic character required by the *Monographiae phanerogamarum*. The letter obviously satisfied de Candolle as is shown by a note written by him on the letter itself: "r. 12. janv. 76. . . accepter." Engler was delighted and reported on 20 January 1876 that he had already made good headway with this work, but that a family in which nearly 2000 species had been described could not really be written up all that soon: on the contrary, for a job like this he would need the greater part of a year.

One century later each monographer reads this statement with some awe and astonishment. Even though 2000 species was a bit on the high side (it turned out to be nearer to 700), it should be realized that the compilers of the *Prodromus*, the *Monographiae* and, a little later, the *Natürliche Pflanzenfamilien*, always thought in terms of dealing with hundreds of species a year. There was definitely much less material, but even so the six day workweek and the twelve hour workday, so characteristic of several of the more productive nineteenth century taxonomists, also contributed to the success of their ambitious undertakings.

Engler now had most of the major collections available, including Schott's Aroids from Vienna but regretted the limited availability of living material. Many a species "die nur auf schwachen Füssen zu stehen scheint" would have to be retained as long as no living material was to be seen.

On 5 July 1876 Engler reported that he went to Vienna for a week [sic] in order to study the living Aroids at Schönbrunn, many of which still date from Schott's time. He said he might have to do the same at Paris and Kew because it was now clear to him that sometimes 5–10 herbarium species would have to be united in one. Even so, he would finish the job by 1877.

De Candolle had asked for a young German taxonomist to come to Geneva for some months to do routine identification. Engler answered

that systematic botany was at a discount in Germany, especially with the University professors who preferred anatomy and physiology. Systematists had little chance to get a professorship "voyez Mr. Ascherson, Peyritsch, moi et autres." He offered to do the job himself if he would be allowed to work half time on his own projects. De Candolle accepted, and Engler worked at Geneva from September onward at the former's expense for a short time.

On 16 January 1877 Engler wrote to thank de Candolle for the time spent at Geneva. He had apparently become very friendly with de Candolle's son Casimir and sent special greetings. The contact with Casimir resulted in an even more extensive correspondence which we have to leave out of account here.

On 16 February Engler reported that he made excellent progress and that printing could begin as far as he was concerned. There were some 100 genera and 700 species of which some 300 are "ready." On 12 June 1877 Engler could state that "die ganze Monographie ist jetzt fertig bis auf die Gattung Philodendron." He had visited Holland in April and found much of importance. The gardeners were now sending him more and more living material.

Engler sent the complete manuscript to Geneva on 8 November 1877. Even though somewhat later than promised, not a bad effort—a 700 species monograph written in eighteen months. He had used cuttings of the *Flora brasiliensis* galley proofs for the diagnoses of the neotropical species: in the era of handwriting and publishing without administrative help, anything set in type was anxiously saved and used for multiple purposes. Printing would now begin soon, and payment would be forthcoming. De Candolle, grateful, personally guaranteed Engler an honorarium of 60 francs per 16 printed pages.

De Candolle's publisher was Masson at Paris, and de Candolle was to send the manuscript to him to have the book printed in Paris. However, on 8 February 1878, three months after submitting the manuscript, Engler became impatient. In a small way he showed then why and how he could later be so successfully productive. Any delay should be avoided. In later years, when complications arose, Engler would wave them aside, saying "das kostet nur Zeit." In general, Engler was possessed by a germanic "Arbeitswut;" in present day American society he would be called a workaholic. It is remarkable to see how, so early in life and being a young man dealing with an established king of science, Engler found his way. Only seven years after the trauma of the Franco-German war and the Peace of Versailles, a young German author made an established Parisian publisher produce his book in Germany. In his letter Engler pointedly remarked that Masson was apparently not in a hurry and suggested a better and faster way. If the monograph could be printed in München, this might be done by a printer who knew his handwriting (and—not said

explicitly – who could be under Engler's direct control). De Candolle and Masson agreed – a minor miracle – but illustrative of Engler's ingenuity and perseverance.

On 11 April 1878 the printers Wolf and Son at München had been asked by Masson to take on the production, and Engler wrote to speed up the return of the manuscript to München (it arrived actually on 20 April). However, he had a piece of other news. He had been offered and had accepted an appointment as regular professor of botany at the small northern German university town of Kiel. The proofs would have to be sent to Kiel. Engler, however, did not point out that he therefore would not be able to supervise the type-setting and printing himself. The proofs were to be sent to Geneva and Kiel, de Candolle had to send his corrections to Kiel, Engler had to combine them and forward them again to München. Actually this was not such a complication as it might seem. The postal connections in Western Europe were excellent in 1878. Proofs and letters took only a few days to travel from Kiel to Geneva and München, and it is likely that the service was then as fast as, or sometimes even faster than, nowadays.

I shall not follow the subsequent steps of the production in any detail and shall also resist the temptation to quote too much from the very informative letters. Through this correspondence we are much better informed of Engler's activities in these early years and of the development of his ideas than in later periods of his life. Engler became quite introverted in later years and left much less testimony of his personal feelings and thoughts than during this first phase of maturity in München and Kiel. Even so, a few things should be said about the Kiel episode and the continuation of his work with de Candolle.

Engler described Kiel (1 May 1878) as "une jolie place" and was delighted with his independent position. No wonder; the entire University numbered only 250 students, and those who took botany were few. Engler had all the time in the world to spend on his scientific work and on the botanical garden. The latter he reorganized along plant-geographical lines, thus foreshadowing the later success with Berlin-Dahlem. Apart from continuing the monographic work for de Candolle, Engler published his *Versuch einer Entwicklungsgeschichte der Pflanzenwelt*, a book of fundamental importance for his growth towards evolutionary biology and theoretical maturity. He also started the *Botanische Jahrbücher*, and here again the correspondence reveals the genesis of this long lasting enterprise. Engler published 62 volumes of this journal, and today it is still going strong. The *Araceae* was published in September 1879; on 28 December Engler wrote "die Anacardiaceen und Burseraceen können nun in Angriff genommen werden. . . ," and the story starts from the beginning.

Engler was on his way. The first part of the *Entwicklungsgeschichte*

appeared in October 1879, a month after the *Araceae*. The first part of the *Botanische Jahrbücher* followed on 30 April 1880. The foundation had been laid for a fantastic career which would lead to the great synthetic publications such as the *Natürliche Pflanzenfamilien*, the creation of the Berlin-Africa tradition, the setting up of a plant taxonomy institute with a staff which lacked its equal in the world, and last, not least, the creation of "Berlin-Dahlem," a garden and an institute, a library and a herbarium from which emanated much of the best in plant systematics. All this was through the organizational genius, the personal effort and the scientific expansionism of one of the greatest plant taxonomists ever – Adolf Engler.

ACKNOWLEDGMENTS AND NOTES

I am very grateful to the director and the curator of the archives and library of the Conservatoire botanique de Genève for making available to me the letters written by Engler to Alphonse de Candolle. The present account hardly calls for the usual footnotes and literature references. I dealt with Engler's publications in some detail in Stafleu and Cowan, *Taxonomic literature* ed. 2, vol. 2 (1976) as well as in my address delivered at Berlin (September 1979) marking the tercentenary of the Berlin botanical garden – *Engler und seine Zeit* – to be published in – where else? – the *Botanische Jahrbücher*. I refer the reader to these publications for further details. The Berlin address and this *Engler episode* are meant to be first steps to a book on the Engler-era in systematic botany.

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No. 13. **Norton G. Miller and Robert R. Ireland:** A Floristic Account of the Bryophytes of Bathurst Island, Arctic Canada. **Martha A. Sherwood:** New Ostropales from the Collections of the Farlow Herbarium (July 1978).

No. 14. **Carroll W. Dodge:** Edward Angus Burt (1859–1939). **Robert K. Edgar:** Jacob W. Bailey and the Diatoms of the Wilkes Exploring Expedition (1838–1842). **Martha A. Sherwood:** New Phacidiales and Ostropales from the Collections of the Farlow Herbarium (July 1979).

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